



DOCUMENT NUMBER

QTR-2191-001

REV. N/C

TITLE

QUALIFICATION TEST REPORT FOR 450 GALLON CRASHWORTHY FUEL TANK

FOR

U.S. AIR FORCE H-53 HELICOPTER

TEST PERFORMED BY

FIBER SCIENCE DIVISION

CONTRACT NUMBER

F09603-79-C-1642-P20002

PREPARED BY

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APRIL 2, 1982

FIBER SCIENCE DIVISION

SALT LAKE CITY, UTAH 84116

WARNER ROBINS ALC/MMSRCB

ROBINS AIR FORCE BASE, GEORGIA 31098

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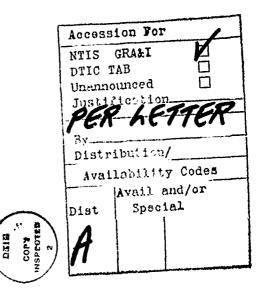
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PREPARED FOR

APPENDIX A QUALIFICATION TEST PROCEDURES QTR-2191 SECTIONS K THRU T





FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTR-2191

DATE:

PAGE

OF

DOCUMENT NUMBER

QTP-2191 SECTION "K"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR ENVIRONMENTAL TESTS

REVISIONS						
LTR.	DATE	PREPARED	APPROVED		RIPTION	
PREPARED BY: DATE: Richard Lyman 1/27/81 CHECKED BY: DATE:		7/81	(FEID	FIBER SCIENCE, INC. SALT LAKE CITY, UTAH		
7. 5 tore 2-10-81 APPROVED BY: DATE: C. G. Patrirle J. 2/10/81			E:	NO. QTP-2191 Section DATE: 1/27/81		

SCOPE

This procedure covers the requirements for Environmental Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter. This document shall only cover environmental requirements for qualification testing for high and low temperature exposure. All other environmental qualification test requirements, humidity exposure, salt spray and dust exposure, are qualified by similarity to the construction of the 650 gallon tank for the CH-53E Helicopter. The 650 gallon tank was qualified by Lear Siegler under contract to the U.S. Navy, Contract No. NO0019-78-C-0137.

2.0 APPLICABLE DOCUMENTS

2.1 <u>MILITARY SPECIFICATIONS</u>

MIL-STD-831

Preparation of test reports.

2.2 FEDERAL SPECIFICATION

TT-S-735

Standard Test Fluid;

Hydrocarbon.

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78

Tank - 450 gallon external fuel,

filament wound lightweight

explosion proof.

2.4 DRAWINGS

FIBER SCIENCE, INC.

2191-001

Tank - installation,

450 Gallon H-53

SARGENT FLETCHER

27-450-4400

Pylon assembly

450 gallon fuel tank.



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NO. QTP-2191 Section "K"

DATE: 1/17/81 PAGE 2 OF 20

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One dried tank assembly (2191-001) mounted to a pylon (27-450-4400) which in turn is mounted in a test chamber shall be fueled to a full tank condition with Type II test fluid per TT-S-735 and then subjected to the Environmental Qualification Tests of Paragraph 4.6.17 as described in Technical Exhibit ASD/ENFEA-78.

3.2 TEST ARRANGEMENT

The test arrangement shown in Figure 1 shall be such as to take all reasonable precautions to simulate the actual environmental conditions of the tank and pylon while mounted on the helicopter.

3.3 TEST METHOD

The tank after drying for one day at 160° F \pm 5° F shall be filled with Type II test fluid per TT-S-735 and suspended in a 2° nose down position in a test chamber. The tank shall then be pressurized to 15 psi and subjected for three (3) days to the low temperature exposure of -65° F \pm 5° F, drained, examined, refilled, pressurized and subjected to the high temperature exposure of $1/160^{\circ}$ F \pm 10° F for three (3) days. There shall be no evidence of leakage.

3.4 TEST INSTRUMENTATION

A staining agent of fluorescent dye shall be mixed in the Type II test fluid to aid in the detection of any fluid leakage during the test. A soap solution shall be used above the test fluid level as shown in Figure 1 to detect leakage. Pressure and temperature shall be monitored continuously during the test by a continuous recording device or round the clock manning of the test.

3.4.1 <u>INSTRUMENTATION CALIBRATION</u>

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.



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NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 3 OF 20

3.5 TEST PRODECURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

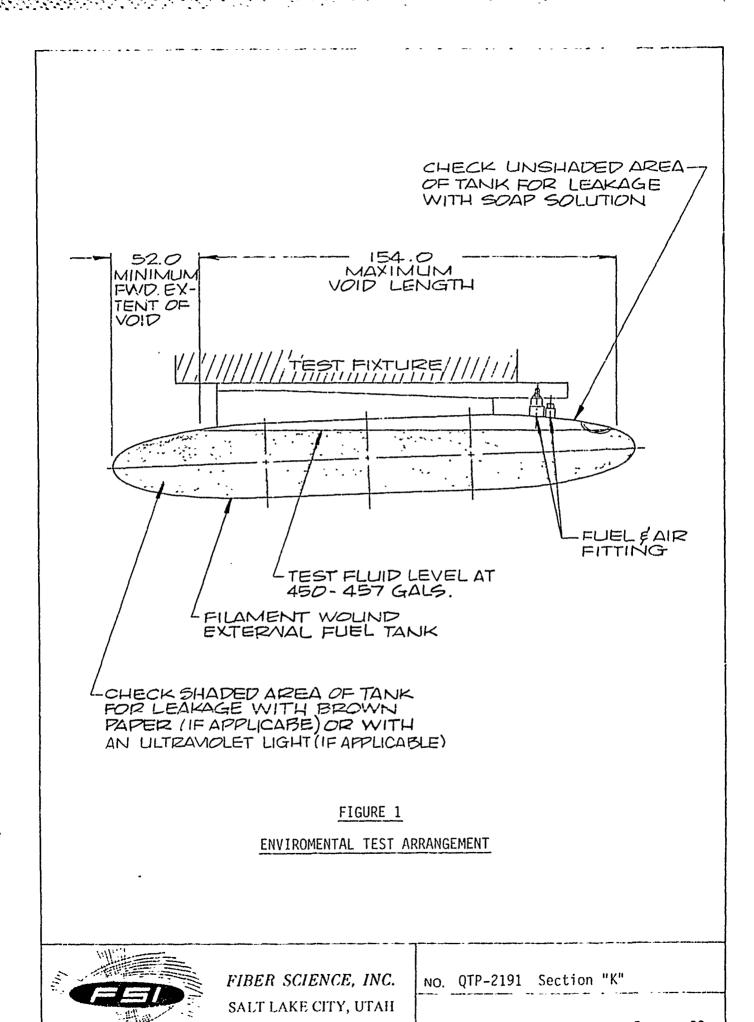
At the conclusion of testing a test report will be prepared for submission to the contractor.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 4 OF 20



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DATE: 1/27/81

PAGE 5 OF 20

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the environmental test fixture for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted in an environmental test chamber by means of the simulated airframe adaptor and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

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The test arrangement shall be examined for compliance with this procedure or shall be deemed to be in compliance with this procedure and the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an F.S.I. authorized Test Engineer and an authorized Government representative.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: pressure gauges, temperature gauges or recorders shall be installed and leads properly tethered so as to have little or no affect on the test. Temperature sensing devices shall be located to best establish the mean temperature of the test chamber and test article.



FIBER SCIENCE, INC.
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NO QTP-2191 Section "K"

DATE: 1/27/81 PAGE 6 OF 20

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation or equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science lest Engineer.

4.5 TEST ARTICLE DRYING

Dry empty tank and integral pylon for 24 hours at 160° F \pm 5° F. All access openings shall be open during the drying process. Temperature shall be continuously monitored (manned) or recorded) during the drying time.

4.6 FUELING

The tank shall be filled with 450 to 457 gallons of Type II test fluid per TT-S-735 through the filler cap opening. A satisfactory staining agent, for brown paper leak detection, or a fluorescent dye, for ultra-violet light leak detection shall be added to the test fluid. The amount of leak detection agent to be added to the test fluid shall be determined.

4.7 ENVIRONMENTAL TEST

Upon completion of the drying of the test article per Paragraph 4.5 and fueling per Paragraph 4.6, perform the following tests:

4.7.1 LOW TEMPERATURE TEST

The tank mounted in the test chamber, filled with the test fluid and properly prepared for leak detection (cover entire tank with brown paper for leak detection if a staining agent is used in the fluid) shall be pressurized to 15 ± 2 psi cooled to -65° F \pm 5° F. The tank shall be held at the -65° F \pm 5° F temperature for 72 hours.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 7 OF 20

4.7.1.1 LOW TEMPERATURE TEST EXAMINATION

Upon completion of the 72 hour low temperature test, examine the tank for any sign of leakage. Any leakage shall be considered as a tank failure. Empty tank and visually inspect for any unsatisfactory condition including a tap test for delaminations.

4.7.2 HIGH TEMPERATURE TEST

Refuel the tank to the requirements of Paragraph 4.6, secure all access and fuel line openings and pressurize the tank to 15 \pm 2 psi. Increase chamber temperature to 160° F \pm 10° F and maintain for 72 hours.

4.7.2.1 HIGH TEMPERATURE TEST EXAMINATION

Upon completion of the 72 hour high temperature test, examine the tank for any sign of leakage. Any leakage shall be considered as a tank failure. Empty tank and visually inspect for any unsatisfactory condition including a tap test for delaminations.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded temperature and pressure data sheets, if such were continuously recorded, and inspection data sheets. The test tank shall be returned to Fiber Science for further testing in the same shipping container it was received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 8 OF 20

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 9 OF 20

TEST DATA SHEET

QTR-2191 SECTION "K"

Testing Activity	Activity Test Engr.
Tank Serial No.	F.S.I. Test Engr.
Test Date	Government Rep.
Ref. Para. 4.1:	EXAMINATION OF PRODUCT Visual Inspection
	Delaminations (Tap Test)
Pof Para 12.	MOUNTING Aircraft Simulated Attachment
NEI. FOIG. 4.2.	Deviations If Any
-	
	FIBER SCIENCE, INC. NO. QTP-2191 Section "K"

SALT LAKE CITY, UTAH

DATE:1/27/81

PAGE 10 OF 20

ARRANGEMENT

Ref. Para. 4.3:	APPROVED TEST ARRANGEMENT AND ASD/ENFEA-78 TECHNI	(REF. FIGURE 1	
	Testing Activity Approval		
	Approved By		Date
	F.S.I. Test Engineer Appr	oval	•
	Approved By		Date
	Government Approval		
	Approved By		Date
	Minimum of two signatures		
	INSTRUMENTAT	<u>ION</u> .	
Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CAL	IBRATION	
	ITEM	CAL	IBRATION DATE
	Test Chamber (If Applicab	le)	
	Temperature Recorder (If Applicable)		
	Temperature Gauge	***************************************	والكاملة الماسلة الماسلة الماسلة المواجئة الماسلة المواجع والماسلة المواجع والمواجع
	Pressure Recorders (If Applicable)	*************************************	
	Pressure Gauges	a de militar de marco en mario de la compansión de la compansión de la compansión de la compansión de la compa	
	Other Instruments:		هند الله الله الله الله الله الله الله الل
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Ref. Para. 4.4.2:	CHECK PROPER INSTALLATION	<u> </u>
	ITEM	REMARKS
	Tank	
	Simulated Aircraft Adaptor	
	Cooling Source	
	Heating Source	
	Recorders (If Applicable)	
	Gauges	Station representation constitute consequents for a service consequence of the service of the service consequence of the service of the servi
	Other Instruments:	
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Ref. Para. 4.4.3:	CHECK PROPER OPERATION	
	ITEM	<u>REMARKS</u>
	Cooling Source	
	Heating Source	
	Gauges	
	Recorders (If Applicable)	
	Other Instruments:	
	1	
	2	
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DRYING

	ORTING	
Ref. Para. 4.5:	DRY EMPTY TANK AND PYLON	
	ITEM	<u>REMARKS</u>
	Tank Condition (Empty)	
	Access Ports (Open)	
	Temperature ($160^{\circ} \text{ F} \stackrel{+}{.} 5^{\circ} \text{ F}$)	
	Time at Temperature (24 Hrs)	
	Temperature Monitoring (Manned or Recorded)	
	FUELING	
Ref. Para. 4.6:	FUEL TANK AT PROPER ATTITUDE	
	ITEM	REMARKS
	Attitude (2 ⁰ Nose Down)	
	Fill with 450 to 457 Gal. Type II Test Fuel	
	Type of Leak Detecting Additive	
	Amount of Leak Detecting Additive	
	Secure All Openings	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 13 OF 20

ENVIRONMENTAL TEST

LOW TEMPERATURE TEST

Ref. Para. 4.7.1:	WITH ALL EQUIPMENT AND IN PROPERLY, PRESSURIZE TANK START COOL DOWN.	
	TTEM	OPERATION

OPERATION REMARKS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 14 OF 20

LOW TEMPERATURE EXAMINATION

Ref.	Para.	4.7.1.1:	CHECK LEAKAGE, DAMAGE AND APPEARANCE
			Brown Paper Dye Stain Examination for Leakage (If Applicable):
			Ultra Violet Light Dye Detection for Leakage (If Applicable):
			`
			Soap Solution Test Void Area for Leakage (See Figure 1):



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 15 OF 20

•	DRAIN TANK, RELIEVE PRES Visual Examination	Plus September 120 Marriage			•		
	Condition of Outside Surface						
	Condition of Liner						
	Condition of Fittings						
	Condition of Seals						
	Delaminations (Tap Test)						
	FIBER SCIENCE, INC.	NO.	QTP-2191	Section	"K"		
and like	SALT LAKE CITY, UTAH	DATE:	1/27/81	PAGE	16	OF	20

HIGH TEMPERATURE TEST

Ref. Para. 4.7.2:	REFUEL TANK, RESET INSTRU CLOSE CHAMBER AND START W	MENTATION, ARM UP:	PRESS	URIZE TANK,	
	ITEM	The Section of the Se	<u>OPE</u>	RATION REMARKS	
	Chamber Closed (Time)				
	Start Warm Up (Time)				
	Warm Up Rate (^O F/Hr.)				
	Test Temperature (160°F ±	10 ⁰ F)			
	Time Achieved (Chamber)				
	Time Achieved (Tank)				
	Elapsed Time (72 Hrs.)				
	Open Chamber (Time)				
	Removed Test Article (Tim	e)			
	Temperature Recorder	***			
	Pressure Recorder			·	
	Temperature Gauge	414 ***********************************			
	Pressure Gauge				
	Other Instruments:	#*************************************			
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1/27/81 PAGE 17 OF 20

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HIGH TEMPERATURE EXAMINATION

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Ref.	Para.	4.7.2.1:	CHECK LEAKAGE, DAMAGE AND APPEARANCE
			Brown Paper Dye Stain Examination for Leakage (If Applicable):
			Ultra Violet Light Dye Detection for Leakage (If Applicable):
			Soap Solution Test Void Area for Leakage (See Figure 1):
			(See Figure 17.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 18 OF 20

Ref. Para. 4.7.2.1:	DRAIN TANK, RELIEVE PRESSURE AND OPEN ACCESS PORTS
	Visual Examination Condition of Outside Surface
	Condition of Liner
•	1
	Condition of Fittings
	Condition of Seals
	Delaminations (Tap Test)
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "K"

DATE: 1/27/81 PAGE 19 OF 20

EVALUATION OF	DATA
LOW TEMPERATURE TEST:	
HIGH TEMPERATURE TEST:	
GENERAL CONDITION OF TANK:	
	. ,
RECORDER READING:	
•	
FIBER SCIENCE, INC.	NO. QTP-2191 Section "K"
SALT LAKE CITY, UTAH	DATE: 1/27/81 PAGE 20 OF 20

DOCUMENT NUMBER

QIP-2191 SECTION "L"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR STATIC LOADS

REVISIONS					
LTR.	DATE	PREPARED	APPROVED	DESCRIPTION	
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Ric	hard Lyman	1/20/	'81	FIBER SCIENCE, INC.	

NO. QTP-2191

SALT LAKE CITY, UTAH

Section "L"

DATE: 1/20/81 PAGE 1 of 26

CHECKED BY:

DATE:

1.0	SCOPE				
	This procedure covers the requirements for Static Loads Testing of the 450 Callon Filament Wound External Fuel Tank for the H-53 Helicopter.				
2.0	APPLICABLE DOCUMENTS				
2.1	MILITARY SPECIFICATIONS				
	MIL-A-8591	Airborne stores and associated suspension equipment, criteria for.			
	MIL-A-8868	Airplane strength and Rigidity, data and reports.			
	MIL-STD-831	Test reports, preparation of.			
2.2	TECHNICAL EXHIBIT				
	ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof			
2.3	TECHNICAL REPORT	••			
	SR-2191-001	Structural Analysis Report 450 Gallon Tank			

FIBER SCIENCE

2191-001

Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400

Pylon Assembly - 450 gallon fuel tank.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81

PAGE

2 OF 26

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One tank assembly (2191-001) shall be securely fastened to a pylon (27-450-4400) which in turn is mounted to a structural test fixture by means of a simulated airframe adaptor. The tank shall then be fueled to a full tank condition and subjected to the static loads testing corditions of Technical Exhibit ASD/ENFEA-78, Paragraph 4 6.18.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that snown in Figure 1 with all reasonable precautions taker to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST METHOD

The tank secured to the pylon by the pylon support points shall be suspended from the structural test fixture in a 20 nose down position. High tensil fabric strapping connected to a whippletree arrangement shall be placed around the tank at location indicated in Figure 2. The whippletrees shall be connected to load applying devices which shall as near as practical apply the loads to the tank in a simultaneous manner. The tank shall then be filled with water to a full tank condition pressurized to the 15 psi working pressure and the static structural loads applied as follows:

3.3.1. DESIGN LIMIT LOADS

The tank shall be subjected to three (3) critical static limit load conditions (115% of the design loads) as determined by the 450 gallon tank structural analysis report SR-2191 prepared to the requirements of MIL-A-8868 using the loading parameters set forth in the Technical Exhibit ASD/ENFEA-78 from MIL-A-8591 Rev E. One condition of the three selected shall be a crash or hard landing condition. At the conclusion of the test there shall be no evidence of rupture, leakage or structural damage.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 3 OF 26

3.3.2 DESIGN ULTIMATE LOADS

The tank upon completion of the design limit loads test of Paragraph 3.3.1 shall be subjected to the same three (3) load conditions at the ultimate load conditions (150% of the design loads). At the conclusion of the test there shall be no evidence of rupture, leakage or structural damage.

3.3.3 DESTRUCTION TEST

The tank upon completion of the design ultimate loads test of Paragraph 3.3.2 shall be subjected to a static loads destruction test using the loading condition considered most critical in the ultimate loads testing. The actual destructive load values shall be recorded.

3.4 TEST INSTRUMENTATION

Ten (10) biaxial strain gauges as shown in Figure 3, shall be attached to the tank to record structural loading during the test. All applied load measuring devices shall have the capability of recording or establishing the exact applied load at the time of any failure. A full color 16 MM movie shall be taken at various significant conditions during the test. Twelve (12) color still photos shall also be taken of the test setup and various aspects of the test of which at least one third (4) of the still photographs shall be taken of the structural damage caused by the static loads destruction test.

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE 1/20/81 PAGE 4 OF 26

3.6 DOL MENTATION

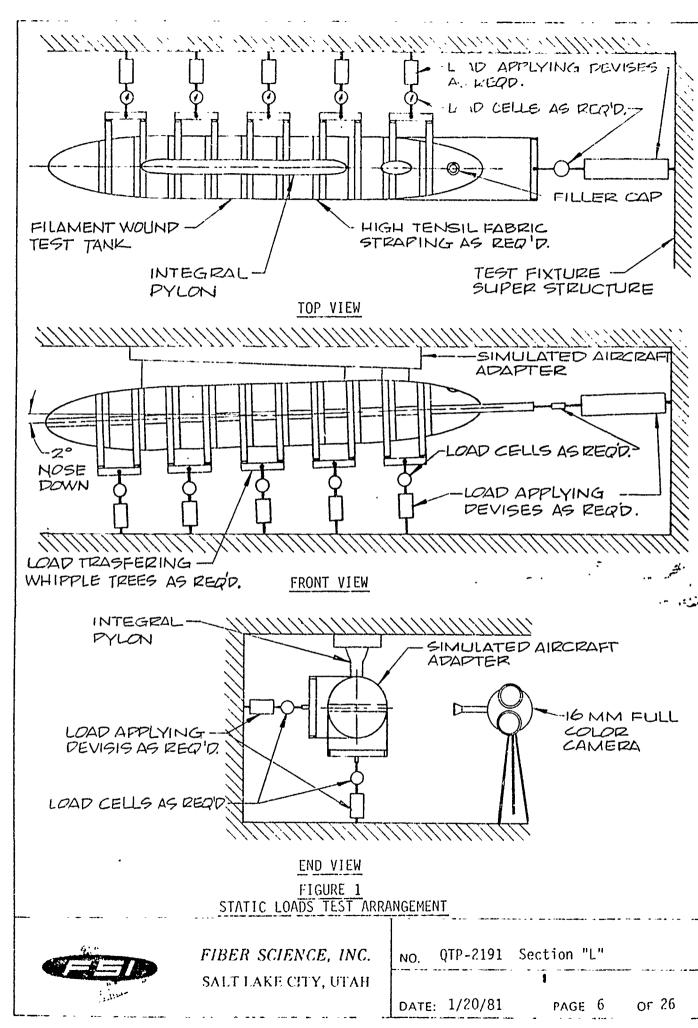
At the conclusion of testing a test report will be prepared for submission to the contractor.

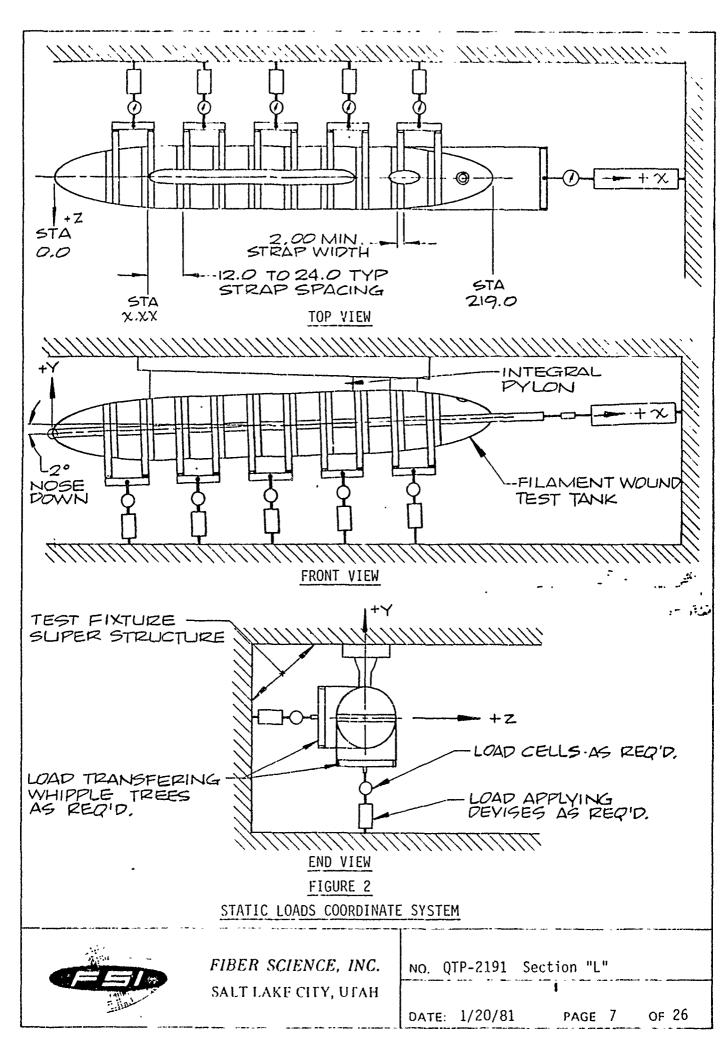


FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 5 OF 26





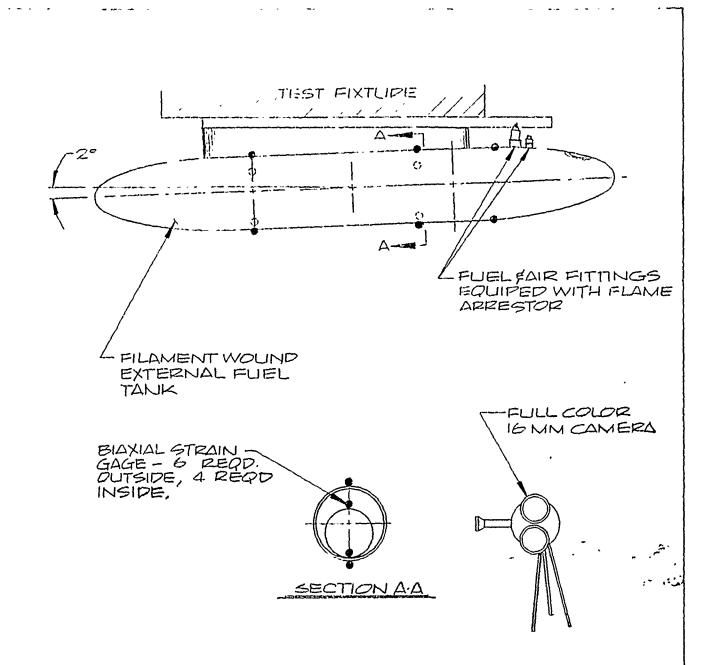


FIGURE 3 STRAIN SENSOR ARRANGEMENT



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NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 8 OF 23

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the structural test fixture for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the structural test fixture by means of the simulated airframe adaptor and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1, 2, and Figure 3 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an F.S.I. authorized Test Engineer and an authorized Government representative.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: cameras, load cells, strain gauges and recorders shall be installed and leads properly tethered so as to have little or no affect on the test. High tensile fabric strapping and connecting whippletrees shall be inspected per Figure 3 for proper location. Strain sensor readings shall be taken at locations indicated in Figure 3 of this procedure.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 9 OF 26

4.4.3 OPERATION

All instrumentation, test equipment and load cells shall be checked for proper operation. Any defects in instrumentation or equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Sciene Test Engineer.

4.5 FUELING

The tank shall be filled with 450 to 457 gallons of water through the filler cap opening. The tank properly mounted (2° nose down) during filling will contain the proper amount when the water begins to overflow out the filler cap opening.

4.6 STATIC STRUCTURAL LOADS TESTING

Pressurize tank to 15 psi and apply the structural loads as follows:

4.6.1 <u>LIMIT LOADS TEST</u>

Apply the three (3) limit load conditions determined by the structural analysis report SR-2191 to be the most critical. One loading condition must be a crash or hard landing condition. At the completion of each of the three test conditions, the tank shall be examined for any evidence of rupture, leakage or structural damage. The entire tank surface shall receive a tap test to determine if any delaminations occurred due to the applied static loads. A sketch shall be made showing approximate size and shape of the delamination.

4.6.2 ULTIMATE LOADS TEST

Reapply the three (3) load conditions of Paragraph 4.6.1 to the ultimate load values determined by the structural analysis report SR-2191. At the completion of each of the three test conditions the tank shall be examined for any evidence of rupture, leakage or structural damage. The entire tank surface shall receive a tap test to determine if any delaminations occurred due to the applied static loads. A sketch shall be made showing approximate size and shape of the delamination.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 10 OF 26

4.6.3 DESTRUCTION TEST

The fiber Science Test Engineer, with the concurrence and approval of the testing activity and the Government representative, shall determine after analyzing the test results from the ultimate loads test, which of the three (3) test conditions shall be used to static test the tank to destruction. The tank shall then be tested to destruction. The location of destructive failure shall be recorded along with the corresponding maximum load values at the initial point of failure. The entire tank surface shall receive a tap test to determine the extent of the failure. A sketch shall be made showing approximate size and shape of the delamination caused by the failure.

4.7 PHOTOGRAPHS

Eight (8) color photographs shall be taken of the test setup and any damage resulting from the limit and ultimate loads test. In addition, four (4) color photographs shall be taken of location where the destructive failure initiated.

4.8 DISSECTION

At the discretion of the authorized Fiber Science Test Engineer, the tank may be cross sectioned to determine the internal extent of the destructive static loads - damage.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded strain data sheets, 16 MM color film, photographs and expended tank. The expended tank shall be returned to Fiber Science for post evaluation in the same shipping container it was received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 11 OF 26

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 12 OF 26

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TEST D/ TA SHEET QTP-2191 SECTION "L"

Testing Activity	Acti-	vity Test Engr.	
Tank Serial No.	F.S.	I. Test Engr.	er odnim me di ma odane outro del propositione approblementation.
			n e dan galatetta e danaganuda tibidaksuntiku dap a titirik sapit
	EXAMINATION OF PRO	ODUCT	
Ref. Para 4.1:	Visual Inspection		
	Delaminations (Tap Test		
			. <i>' مُن</i> ند . '
	MOUNTING		
Ref. Para. 4.2:	Aircraft Simulated Atta	chment	
	Deviations If Any		
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	FIBER SCIENCE, INC.	NO. QTP-2191	Section "L"
	SALT LAKE CITY, UTAH	And the second control of the second control	

DATE. 1/20/81

13 OF 26

PAGE

ARRANGEMENT

Ref. Para. 4.3:	Approved Test Arrangement (Ref. Figure 1,2, and Figure 3 and ASD/ENFEA-78 Technical Exhibit).		
	Testing Activity Approval		
	Approved By		_ Date
	F.S.I. Test Engineer Ap	proval	
	Approved By	ingah Wildelman ada dini da di diringa dini Wildelman ada	Date
	Government Approval		
	Approved By	ng Paramakinang ang dalah dalah dalah dalah badi s ganggapin	Date
	Minimum of two signatur	es required.	
	INSTRUMENTATI	<u>on</u>	
Ref. Pafa. 4.4.1:	CHECK INSTRUMENTATION CALIBRATION		
	ITEM		CALIBRATION DATE
	Load Cells	Whole chains	<u>ئى</u>
	Cameras (If Applicable)		
	Pressure Gauges		
	Strain Gauge Recorders		
	Other Instruments:		
	1.		
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	4		
	FIBER SCIENCE, INC.		Section "L"
	SALT LAKE CITY, UTAH	1/00/01	DAGE 14 OF 36

Ref. Para. 4.4.2:	CHECK PROPER INSTALLATIO	N _.
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	Cameras	to a control the transmission of the control of the
	Strain Gauges	
	Recorders	
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Ref. Para. 4.4.3:	CHECK PROPER OPERATION	· · · · · · · · · · · · · · · · · · ·
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	Pressure Gauges	
	Cameras	
	Recorders	
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	FIBER SCIENCE, INC.	NO. QTP-2191 Section "L"
	SALT LAKE CITY, UTAH	DATE: 1/20/81 PAGE 15 OF 26

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Ref. Para 4.5	FUEL TANK AT PROPER ATTITUDE	
	ITEM	REMARKS
	Attitude (2 ⁰ nose down)	
	Fill With 450 to 457 Gal. Water	
	Secure Filler Cap	

STATIC STRUCTURAL LOADS

Ref. Para 4.6 PRESSURIZE TANK TO 15 + 2 PSIG

ACTUAL PRESSURE



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 16 OF 26

LIMIT LC 'DS

Ref. Para. 4.6.1 APPLY LIMIT LOADS PER SR-2191

See Figure 3 For Coordinates

I T E	APPLIED LOAD STRAP LOCATION	CONDITION I		CONDIT	CONDITION II		ON III
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FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 17 OF 26

Ref. Para. 4.6.1	APPLY LIMIT LOADS PER SR-2191 - (continued)
	POST TEST EXAMINATION
	VISUAL INSPECTION
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81

PAGE 18 OF 26

ULTIMATE LOADS

Ref. Para. 4.6.2 APPLY ULTIMATE LOADS PER SR-2191

See Figure 3 For Coordinates

I	APPLIED LOAD STRAP LOCATION	CONDI	TION I	CONDITION II		CONDITION II CONDITION III		
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 19 OF 26

Ref. Para. 4.6.2	APPLY ULTIMATE LOADS PER SR-2191 - (continued)
	POST TEST EXAMINATION
	VISUAL INSPECTION
	DELAMINATIONS /TAD TEST)
	DELAMINATIONS (TAP TEST)
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 20 OF 26

DESTRUCTIVE LOADS TEST

Ref. Para. 4.6.3	Test condition to which tank sh jected for destructive testing. DESTRUCTIVE CONDITION:	
	F.S.I. Test Engineer Approval	
	Approved By	
	Testing Activity Approval	
	Approved By	Date
	Government Approval	
	Approved By	Date



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 21 OF 26

Ref. Para. 4.6.3 DESTRUCTIVE LOADS TEST (continued)

I	APPLIED LOAD	PLIED LOAD DESTRUCTIVE LOAD CONDITION					
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

DATE: 1/20/81

22 OF 26

Ref Para 463	DISTRUCTIVE LOADS TEST - (continued)
	DESTRUCTIVE FAILURE
	LOCATION
	TYPE OF FAILURE
	EXTENT OF VISUAL FAILURE
	EXTENT OF DELAMINATION FAILURE (TAP TEST)
	PROVIDE SCALED SKETCH OF DELAMINATED AREA (SIZE, LOCATION AND APPROXIMATE SHAPE)
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FIBER SCIENCE, INC. SALT I AKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81

PAGE 23 OF 26

Ref. Para. 4.7	PH-++OGRAPHS					
	Number 1	Photographs and	Identify L	ocations		
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	3.		9.			
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	6.		12.			
Ref. Para. 4.8	DISSECT	ION OF THE TANK		•		
	Approve	d By	Date			
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "L"

DATE: 1/20/81 PAGE 24 OF 26

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GENERAL APPEARANCE:	_
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO.QTP-2191 Section "L"

DATE: 1/20/81

PAGE 25 OF 26

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DATE: 1/20/81

PAGE 26 OF 26

DOCUMENT NUMBER

QIP-2191 SECTION "M"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR FORCED EJECTION

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LTR.	DATE	PREPARED	APPROVED		DES	CRIPTION		
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APPROV	EDBY:	male J.	E: 12/6/80		11/20/00	1	. 1 .	.20
i		•		DATE:	11/29/80	PAGE	: 1 0)₽0

1.0 SCOPE

This procedure covers the requirements for Forced Ejection Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MID-STD-831

Test reports, preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78

Tank - 450 gallon external

fuel, filament wound

lightweight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001

Tank - Installation,

450 gallon H-53

SARGENT FLETCHER

27-450-4400

Pylon Assembly - 450 gallon

fuel tank.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "M"

DATE: 11/29/80 PAGE 2 OF 20

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One tank assembly (2191-001) shall be fueled to a full tank condition and mounted to a pylon (27-450-4400) which in turn is mounted to a functional test fixture by means of the TF-261-178 adaptor. The tank shall be subjected to the impact of a forced ejection of the tank and pylon onto a concrete surface as described in the T chnical Exhibit ASD/ENFEA-78 Paragraph 3.4.1.3.3, Paragraph 3.4.1.6, and Paragraph 3.4.1.7.1.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter including forced ejection release capabilities.

3.3 TEST METHOD

The tank secured to the pylon by the pylon support points shall be suspended from the functional test fixture by means of a TF-261-178 adaptor in a 2 nose down position. The tank shall then be filled with water to a full tank condition with the tank center point (see Figure 1) being 37.3 ± 1.5 inches (48 ± 2" for JP-4 or JP-5 fuel) above a horizontal concrete impact surface. The tank shall be ejected from the functional test stand by means of the pylon ejection system. There shall be no rupture or leakage from impact of the tank with the concrete test surface.

3.4 TEST INSTRUMENTATION

High speed movies positioned so that they are photographing continuously the full length of the tank shall be taken with a 15 mm. full color camera capable of photographing 2000 frames per second minimum at the time of impact. A grided reference plane shall be placed directly behind the tank as shown in Figure 1. The reference plane and tank shall be painted white with black grid lines as shown in Figure 2. Pressure in the tank during the time interval of the impact transient shall be measured and recorded at four points as shown in Figure 3. Ten (10) biaxial strain gauges, as shown in Figure 3, shall also be attached to record tank structural loading during the test. Twelve (12) color still photos shall be taken of the



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. Q1P-2191 Section "M"

DATE: 11/29/80 PAGE 3 OF 20

CC1.100.4/79

impact damaged areas and any other highly stressed or failed areas after the test.

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

At the conclusion of testing a test report will be prepared for submission to the contractor.



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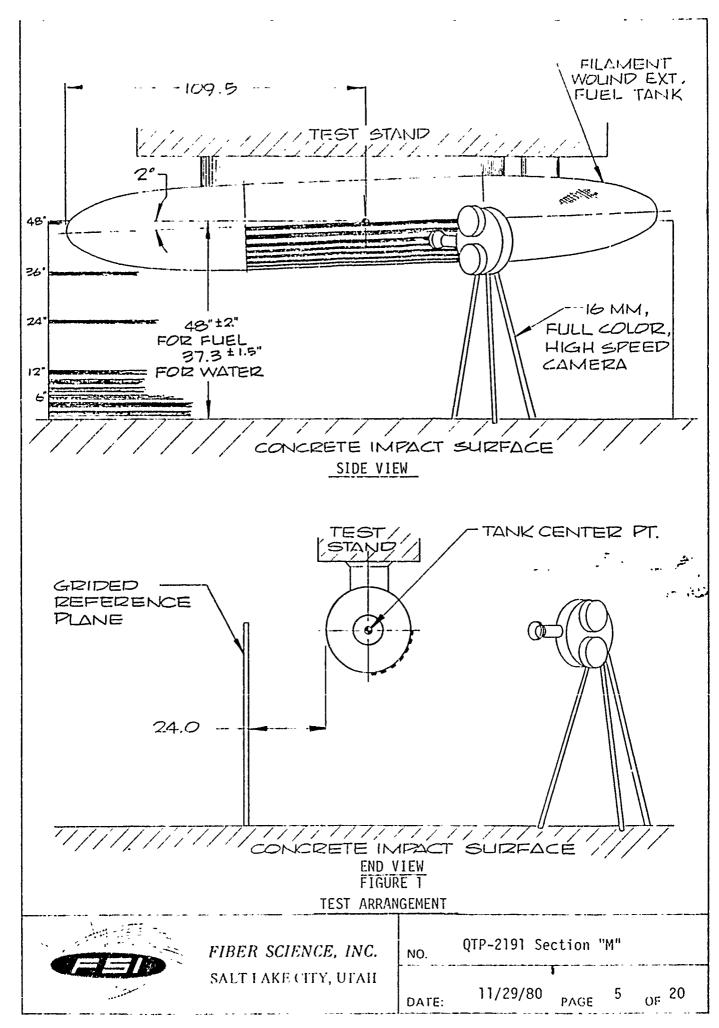
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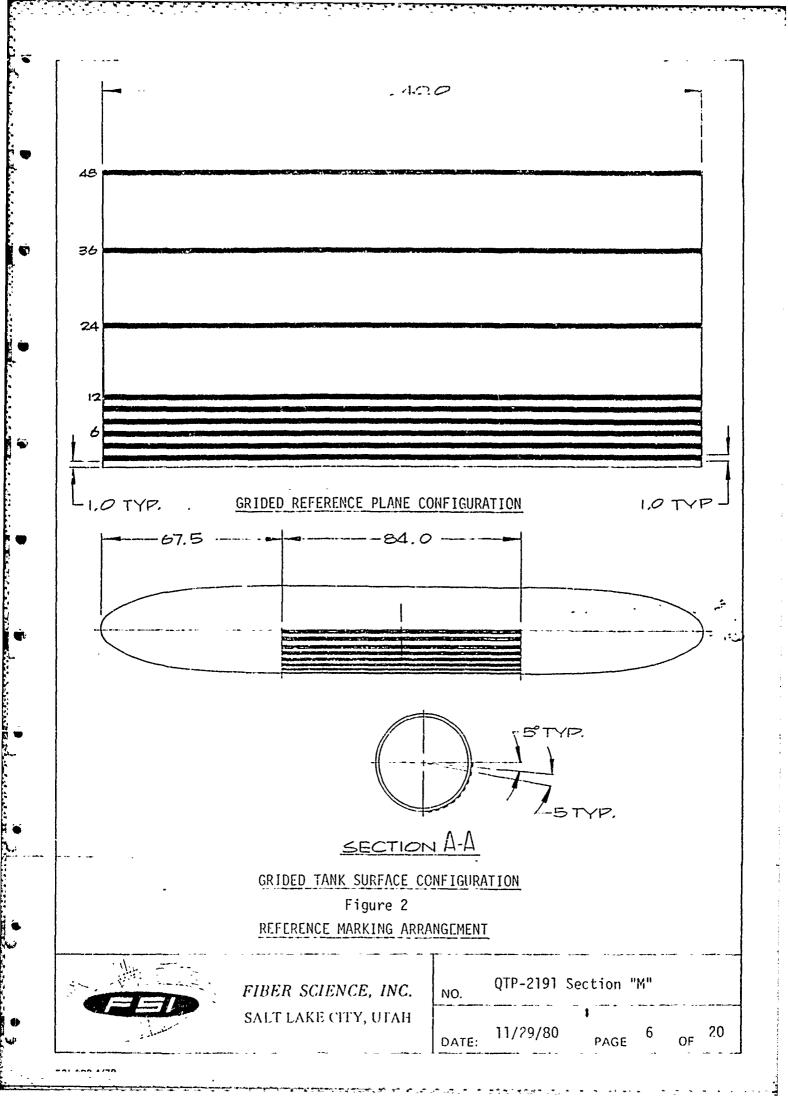
QTP-2191 Section "M"

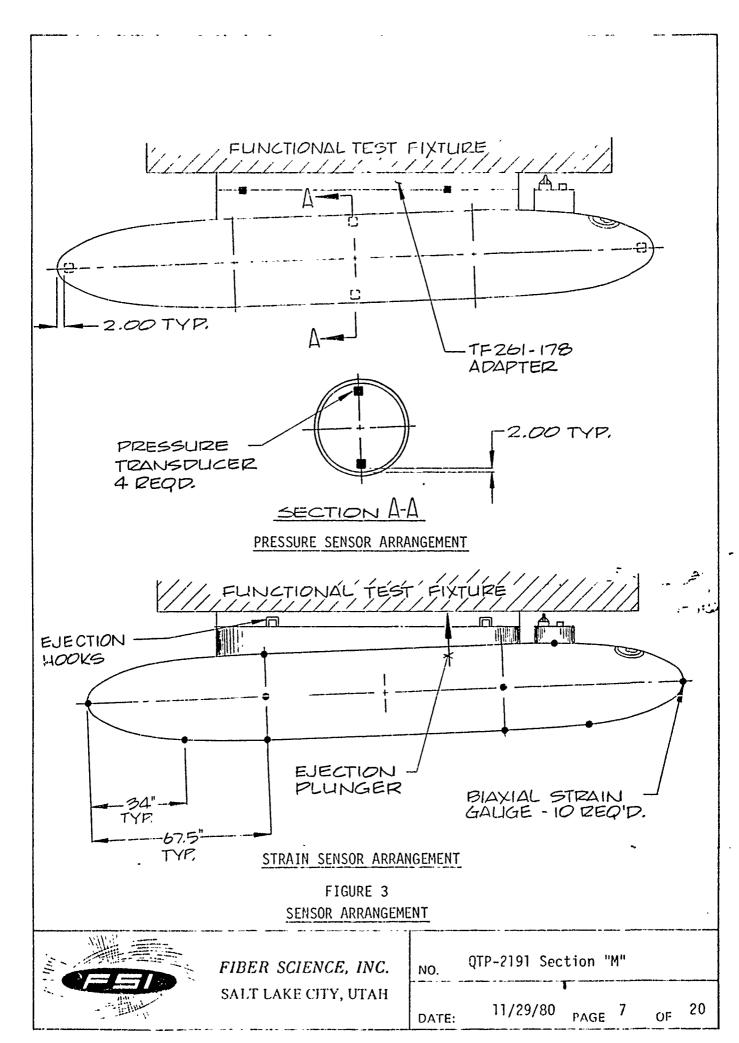
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4 OF







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4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the functional test fixture for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the functional test fixture by means of the TF-216-178 adaptor and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure. 1 and Figure 2 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an F.S.I. authorized test engineer and an authorized Government representative.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 <u>INSTRUMENTATION CALIBRATION</u>

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: cameras, grid reference planes, pressure transducers, strain gauges and recorders shall be installed and leads properly tethered so as to have little or no affect on the test. Pressure and strain readings shall be taken at locations indicated in Figure 3 of this procedure.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "M"

DATE: 11/29/80 PAGE 8 OF 20

691.300-4/70

4.4.3 OPERATION

All instrumentation, test equipment and ejection gun shall be checked for proper operation. Any defects in instrumentation or equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 FUELING

The tank shall be filled with 450 to 457 gallons of water through the filler cap opening. The tank properly mounted (20 nose down) during filling will contain the proper amount when the water begins to overflow out the filler cap opening.

4.6 GUN LOADING

The ejection gun cartridge chamber shall be loaded with 2 cartridges using a standard load. Safety precautions should be taken to insure load is properly installed and that the breach is properly closed and locked.

4.7 FORCED EJECTION IMPACT

With all instrumentation synchronized and ready for operation, the ejection gun shall be discharged forcing the tank downward to impact the concrete surface.

4.8 POST FORCED EJECTION IMPACT EXAMINATION

4.8.1 LEAKAGE

There shall be no leakage from the tank caused by the forced ejection.

4.8.2 DELAMINATIONS

The entire tank surface shall receive a tap test to determine if any delaminations occurred outside the impact area. A sketch shall be made showing approximate size and shape.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "M"

DATE: 11/29/80 PAGE 9 OF 20

4.8.3 FORCED EJECTION IMPACT IMPRINT

The tank impact surface imprint configuration shall be graphically sketched and dimensioned.

4.8.4 PHOTOGRAPHS

Twelve (12) color photographs of the damaged areas at locations determined by the testing activity and the Fiber Science Test Engineer.

4.8.5 DISSECTION

At the discretion of the authorized Fiber Science Test Engineer, the tank may be cross sectioned to determine the internal extent of the crash impact damage.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded pressure and strain data sheets, high speed film, photographs and expended tanks. Expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "M"

DATE: 11/29/80 PAGE 10 OF 20

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "M"

DATE: 11/29/80

PAGE

11 OF 20

TEST DATA SHEET QTP-2191 SECTION "M"

Testing Activity	Act	ivity Test Engr	•			
Tank Serial No.	F.S	.I. Test Engr.				
Test Date	Gov	Covernment Pop				
	EXAMINATION OF P	RODUCT				
Ref. Para. 4.1	Visual Inspection					
	Delaminations (Tap Tes					
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	MOUNTING					
Ref. Para 4.2	Aircraft Simulated Att	achment				
	Deviations If Any					
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DATE: 11/29/80

12 OF 20

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	ARRANGLMENT			
Ref. Para. 4.3:	Approved Test Arrangement ASD/ENFEA-78 Technical Ex		e 1, Figure 2 &	
	Testing Activity Approval			
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	Approved By		Date	
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Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CAL	IBRATION		
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PAGE 13

OF 20

DATE: 11/29/80

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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QPT-2191 Section "M"

DATE: 11/29/80 PAGE 14 OF 20

	ITEM		REMĄRKS
Ref. Para. 4.7 (continued)	Other Instruments:		
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Ref. Para. 4.8.2	<u>DELAMINATIONS</u> Results of Tap Test fo	or Delaminations	
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	FIBER SCIENCE, INC.	NO. QTP-2191	Section "M"

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DATE: 11/29/80

PAGE 16 OF 20

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f. Para. 4.8.4	PHOTOGR	APHS		
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17 OF 20

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NO. QTP-2191 Section "M"

DATE 11/29/80

PAGE 18 OF 20

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NO. QTP-2191 Section "M"

DATE: 11/29/80

PAGE 19

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DOCUMENT NUMBER

QIP-2191 SECTION "N"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR FUEL VAPOR IGNITION TEST

	REVISIONS					
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1 0 SCOPE

This procedure covers the requirements for fuel vapor explosion testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831

Test Reports, Preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78

Tank - 450 gallon external fuel, filament wound lightweight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE 2191-001

Tank - Installation, 450-gallon H-53

SARGENT FLETCHER 27-450-4400

Pylon Assembly - 450 gallon fuel tank.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 2 OF 14

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One tank assembly (2191-001) equipped with an approved ignition device and mounted to a pylon (27-450-4400) which in turn is mounted to a suitable test fixture shall be subjected to a fuel vapor ignition of N-Pentane/air mixture of the proper fuel/air ratio as described in Technical Exhibit ASD/ENFEA-78, Paragraph 3.4.1.7.3.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST METHOD

The tank shall be suspended at the pylon attach points, in a 20 nose down position, from a suitable test fixture. The aft access opening shall be replaced with a suitable fixture incorporating a spark plug or other ignition device. The tank shall be dry and free of fuel. A N-Pentane/air mixture of the proper fuel/air ratio shall be introduced into the tank at atmospheric pressure to provide an energy source. The fuel/air mixture must be such that the pressure rises to at least 6.5 atm in 60 milliseconds or less. This mixture will then be ignited by the ignition device and the effect on the tank observed.

The tank fuel and air connections, equipped with flame arrestors, shall be observed to determine whether a flame propagates through these connections during the test.

3.4 TEST INSTRUMENTATION

A high speed 16 mm color movie shall be taken with a Fast-X camera capable of photographing 2000 frames per minute minimum. Pressure in the tank during the time interval of the vapor ignition transient shall be measured and recorded at four points as shown in Figure 1. Four color still photos shall be taken of any external damage areas after the test.



FIBER SCIENCE. INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 3 OF 14

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within - 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with paragraph 4 of this document.

3.6 DOCUMENTATION

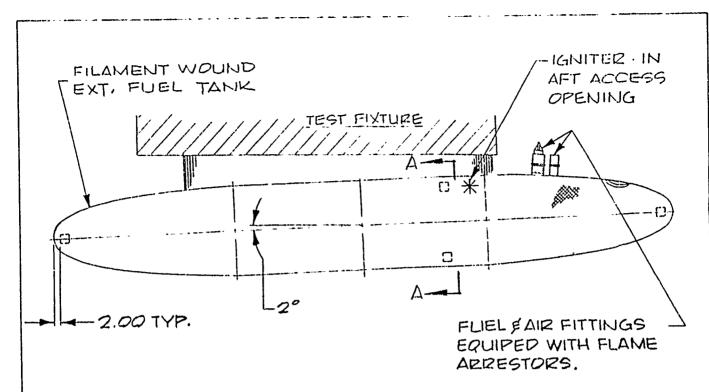
At the conclusion of testing a test report will be prepared for submission to the contractor.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 4 OF 14



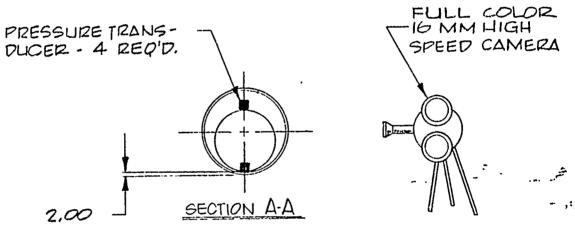


FIGURE 1
VAPOR IGNIIION ARRANGEMENT



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 5 OF 14

4.0 QUALIFICATION TEST PROVISIONS

4.1 <u>EXAMINATION OF PRODUCT</u>

The tank and pylon shall be fully examined prior to mounting to the test fixture for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: igniter, camera, pressure transducers, and recorders shall be installed in such a way as * to best satisfy the intent of the test. Pressure and strain readings shall be taken at locations indicated in Figure 1 of this procedure.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 6 OF 14

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 PRIMING TANK

The tank shall be dry and free of fuel. A N-Pentane/air mixture of the proper fuel/air ratio shall be introduced into the tank at atmospheric pressure at the forward access opening or the filler cap, to provide the proper fuel/air ratio for ignition.

4.6 <u>FUEL VAPOR IGNITION TEST</u>

Remove or lock in a depressed (open) position the fuel and air spill valves. With all instrumentation synchronized and ready for operation, the N-Pentane/air mixture shall be ignited and the reaction recorded.

4.7 POST FUEL VAPOR IGNITION EXAMINATION

Visually inspect and tap test entire surface of tank for delaminations. Record all external damage if any to the outside surface of tank. Remove both access openings and filler cap and visually inspect the interior of the tank. Record all internal damage to the tank shell, frames, baffles, fittings or tubing. Photograph all internal and external, if any, damage. Identify photographs by number and location.

5.0 QUALIFICATION REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorder pressure data sheets, high speed film and photographs. The test tank shall be returned to Fiber Science for further testing in the same shipping container it was received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 7 OF 14

APPENDIX "A" TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

Section "N" NO. QTP-2191

DATE: 11/18/80

PAGE

OF 14

TEST DATA SHEET

QTR-2191 SECIION "N"

Testing Activity_	Act	tivity Test Engr
Tank Serial No	F.S	S.I. Test Engr.
Test Date	Gov	vernment Rep.
	EXAMINATION OF F	PRODUCT
Ref. Para. 4.1:		
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		st)
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		ىنىڭ ئورىنىدىن.
	MOUNTING	
Ref. Para. 4.2	Aircraft Simulated Att	cachment
	Deviations If Any	
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	DANCE COLUMN	
TED	FIBER SCIENCE, INC. SALT LAKE CITY, UTAH	NO. QTP-2191 Section "N"
	Simp willed with A g O A Fill	DATE: 11/18/80 PAGE 9 OF 14

	ARRANGEMENT					
Ref. Para. 4.3:	Approved Test Arrangemen (Ref. Figure 1 & ASD/EN	nt Including I FEA-78 Technic	gnition Devi al Exhibit.)	ce		
	Testing Activity Approve	al				
	Approved By		_ Date		,	
	F.S.I. Test Engineer App	proval	·			
	Approved By		Date			
•	Government Approval					
	Approved By		_ Date			
	Minimum of two signature	es required.				
	INSTRUMENTATION	<u> </u>				
Ref. Para. 4.4.1	CHECK INSTRUMENTATION CA					
	ITEM	<u>.</u>	CALIBRATION	DATE		٠ نشي
	Igniter (If Applicable)					ن آن
	Cameras (If Applicable)				·	
	Pressure Transducer Rec	order				
	Timing Devices	~~~~~				
	Other Instruments:					
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	2					
	3					
	4					
Mul'					- 	
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Ref. Para 4.4.2:	CHECK PRUPER INSTALLATION	<u>N</u>
	ITEM	REMARKS
	Igniter	
	Cameras	
	Pressure Transducers	
	Recorders	
	Other Instruments:	
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Ref. Para 4.4.3:	CHECK PROPER OPERATION	
	ITEM	REMARKS
	Igniter	N 1481 - No. 1441 - No.
	Cameras	
	Pressure Transducers	: - , i
	Recorders	
	Other Instruments:	
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	FIBER SCIENCE, INC.	NO. QTP-2191 Section "N"
	SALT LAKE CITY, UTAH	

DATE. 11/18/80 PAGE 11 OF 14

PRIMING TANK

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Ref. Para. 4.5:	PRIME TANK WITH PROPER N	II XTURE
	ITEM	REMARKS
	Access opening in which was introduced to the ta	primer nk.
	N-Pentane/air ratio used achieve 6.5 atmospheres 100 psi) in 60 milliseco 1 2 3 45	to (95 to nds.
	Secure Access Upening.	
Ref. Para. 4.6:	FUEL VAPOR IGNITION INGITE FUEL VAPORS WITH A SYNCHRONIZED	
	ITEM	OPERATION REMARKS
	Igniter	
	Pressure Achieved	
	Camera	
	Pressure Transducers	
	Recorders	
	Other Instruments:	
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POST FUEL VAPOR IGNITION EXAMINATION

Ref. Para. 4.7:	EXAMINE TANK FOR THE FOLLOWING:
	Visual Inspection
	Delaminations (Tap Test)
	Internal Damage Tank Shell
	Frames ·
	Baffles
	Fittings
	Tubing



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "N"

DATE: 11/18/80 PAGE 13 OF 14

	EVALUATION OF	DATA		
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INTERNAL DAMAGE:				· · · · · · · · ·
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DOCUMENT NUMBER

QTP-2191 SECTION "O"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR GUNFIRE TEST

	REVISIONS			
LTR.	DATE	PREPARED	APPROVED	DESCRIPTION
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	•			FIBER SCIENCE, INC.
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SCOPE 1.0

> This procedure covers the requirements for ballistic testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831

Test Reports, Preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78

Tank - 450 gallon external fuel, filament wound lightweight explosion proof.

2.3 **DRAWINGS**

FIBER SCIENCE

2191-001

Tank - Installation, 450 gallon

H-53

SARGENT FLETCHER

27-450-4400

Pylon Assembly - 450 gallon

fuel tank.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "O"

DATE: 11/18/80 OF 16 PAGE 2

3.0 REQUIREMENTS

3.1 TEST_ARTICLES

Two tank assemblies (2191-001) fueled to a full tank condition and mounted to a pylon (27-450-4400) which in turn is mounted to a test stand shall be subjected individually to the impact of a single projectile as described in Technical Exhibit ASD/ENFEA-78, paragraph 3.4.1.7.2.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST METHOD

The tanks shall be suspended in a 20 nose down position by the pylon supports attached to a suitable test fixture and filled to the normal full condition with water. The tank shall be impacted by a 14.5 mm armor diercing projectile at an impact velocity of 3200 ft. per sec. from a distance of 75 feet. The projectile trajectory shall be in the horizontal plane and intersect the tank center, and be approximately perpendicular to the longitudinal centerline. Refer to Figure 1.

3.4 TEST INSTRUMENTATION

High speed color movies shall be taken with a Fast-X camera capable of photographing 2000 frames per second minimum, of the projectile entrance and exit areas. Pressure in the tank during the time interval of the impact transient shall be measured and recorded at four points as shown in Figure 2. Four color still photos shall be taken of the entrance and exit areas and any other damaged areas after the test.

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within $\pm 2\%$ of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "O"

DATE: 11/18/80 PAGE 3 OF 16

3.5 TEST PROCEDURES

The test procedures shall be in accordance with paragraph 4 of this document.

3.6 DOCUMENTATION

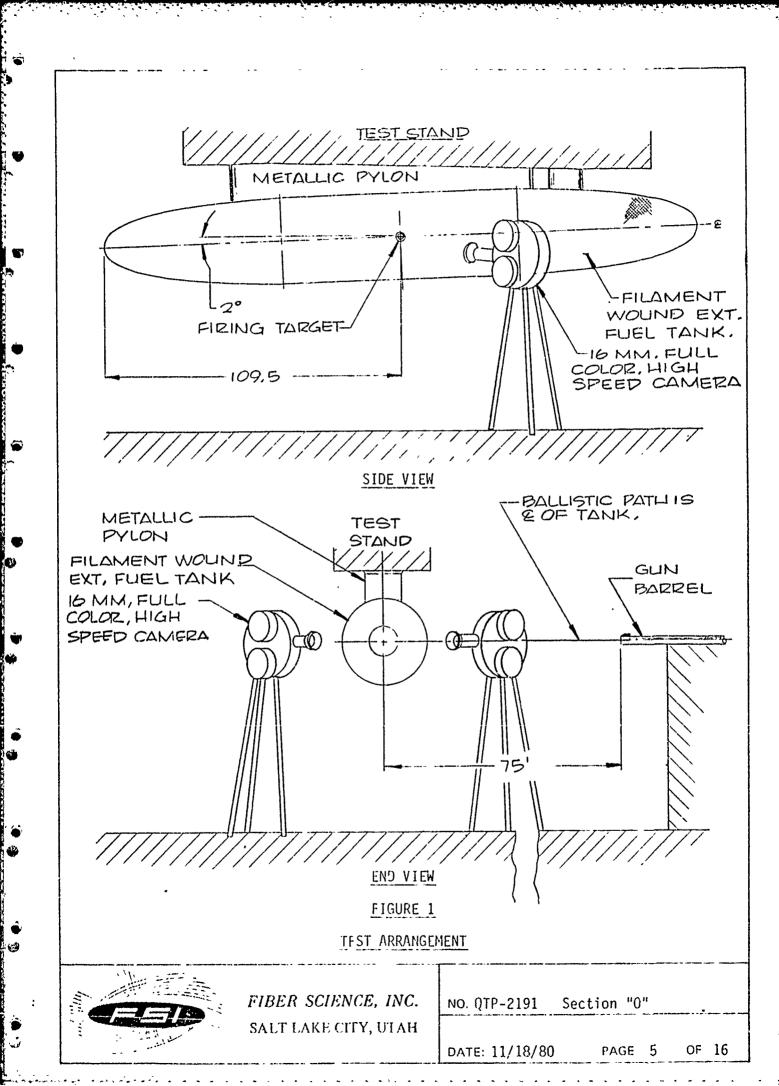
At the conclusion of testing a test report will be prepared for submission to the contractor.

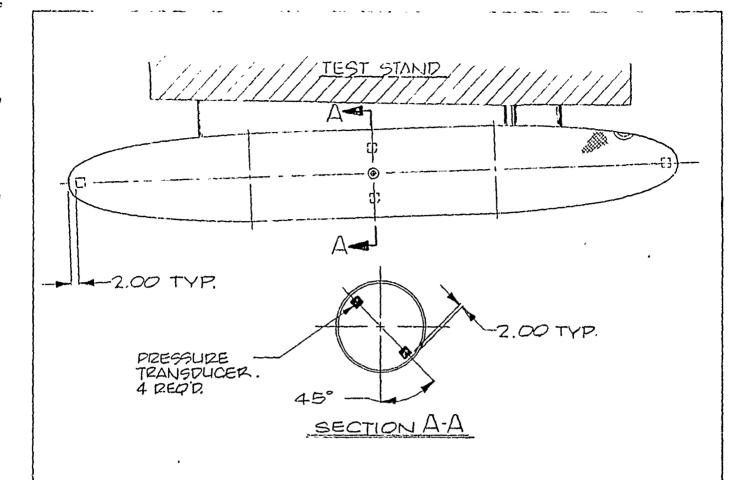


FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

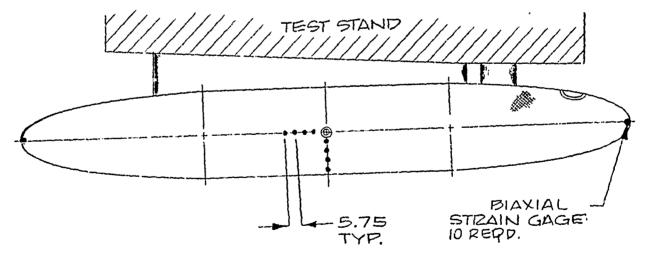
NO. QTP-2191 Section "O"

DATE: 11/18/80 PAGE 4 OF 16





PRESSURE SENSOR ARRANGEMENT



STRAIN SENSOR ARRANGEMENT

FIGURE 2

SENSOR ARRANGEMENT



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NU. QTP-2191 Section "O"

DATE: 11/18/80

PAGE 6 OF 16

4.0 QUAILIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the test stand for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 <u>INSTALLATION</u>

All instruments and test equipment: gun, cameras, pressure transducers, strain gauges and recorders shall be installed in such a way as to best satisfy the intent of the test. Pressure reading shall be taken at locations indicated in Figure 2 of this procedure.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "O"

DATE: 11/18/80 PAGE 7 OF 16

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 FUELING

The tank shall be filled with 450 to 457 gallons of water through the filler cap opening. If the tank is properly mounted (2^{O} nose down) the tank will contain the proper amount when the water begins to overflow out the filler cap opening.

4.6 GUNFIRE TEST

With all instrumentation synchronized and ready for operation, the gun shall be loaded with one 14.5 mm. round and fired and the effects recorded.

4.7 POST GUNFIRE EXAMINATION

Examine projectile created orifice in tank wall at entrance and exit. The orifice area shall not be larger than the projected area of the projectile as it entered or exited the tank. Record measurements on the data sheet. Examination of entire tank surface should be made to determine visual appearance, fractured or broken rovings. In addition, the entire tank surface should receive a tap test to determine if any delaminations occurred. Record all pertinent information including four still photographs each of round entrance and exit orifice.

5.0 QUALIFICATION TEST REPORT

A formal qualification testreport shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorder pressure and strain data sheets, high speed film, photographs and expended tanks. The expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

No. QTP-2191 Section "0"

DATE: 11/18/80 PAGE 8 OF 16

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section"0"

DATE: 11/18/80 PAGE 9 OF 16

TEST_DATA_SHEET

QTR-2191 SECTION "O"

Testing Activity	Activity Test Engr.
Tank Serial No.	F.S.I. Test Engr.
Test Date	Government Rep.
	EXAMINATION OF PRODUCT
Ref. Para. 4.1:	Visual Inspection
	Delaminations (Tap Test)
	<u>MOUNT ING</u>
Ref. Para 4.2:	Aircraft Simulated Attachment
	Deviations If Any
•	
	FIBER SCIENCE, INC. NO QTP-2191 Section "O"

SALT LAKE CITY, UTAH

DATE: 11/18/80 PAGE 10

ARRANGEMENT

Def Deve 4.2	Annual Test Assessment (Def. Fig.	0 0 000/50550 70
Ref. Para. 4.3:		re 2 & ASU/ENIEA-78
	Technical Exhibit.)	
	Testing Activity Approval	
	Approved By	Date
	F.S.I. Test Engineer Approval	
	Approved By	Date
	Government Approval	
	Approved By	Nate
	Minimum of two signatures required.	
	INSTRUMENTATION	
Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CALIBRATION	
	ITEM	CALIBRATION DATE
	Gun (If Applicable)	
	Cameras (If Applicable)	
	Pressure Transducer Recorder	Section to the Commission of t
	Strain Gauge Recorder	
	Timing Devices	
	Other Instruments:	
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	FIBER SCIENCE, INC. NO. QTP-2	191 Section "O"



SALT LAKE CITY, UTAH

11/18/80 DATE:

PAGE 11

of 16

Ref. Para 4.4.2:	CHECK PROPER INSTALLATION	
	ITEM	REMARKS
	Gun	
	Cameras	
	Pressure Transducers	
	Strain Gauges	
	Recorders	
	Other Instruments	
	1.	
Ref. Para 4.4.3:	CHECK PROPER OPERATION	
	ITEM	REMARKS
	Gun	
	Cameras	
	Pressure Transducers	
	Strain Gauges	
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "0"

DATE: 11/18/80 PAGE 12 OF 16

FUEL ING	
FUEL TANK AT PROPER ATTITUDE	L
ITEM	REMARKS
Attitude (2º Nosedown)	
Fill With 450 Gal. Water	
Secure Filler Cap	
GUNFIRE TEST	•
FIRE GUN WITH ALL INSTRUMENT	ATION SYNCHRONIZED
ITEM	OPERATION REMARKS
Gun	
Cameras .	
Pressure Transducers	
Strain Gauges	
Recorders	
Other Instruments	
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "O"

DATE: 11/18/80 PAGE 13 OF 16

POST GUNFIRE EXAMINATION

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Ref. Para. 4.7:	EXAMINE TANK FOR THE FOILOWING:	
	ITEM	REMARKS
	Initial Round Area	P-B-Rich at 1- 100000- Nov-Statemphintopy and population and the State S
	Round Entrance Orifice Area	
	Exit Round Area (If round can be retrieved unmodified.)	
	Round Exit Orifice Area	
	Visual Inspection	
	Delaminations (Tap Test)	
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FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "O"

DATE: 11/18/80 PAGE 14 OF 16

Ref. Para. 4.7:	Color Photographs	
	LOCATION	PHOTO NO.
	Entrance	(_) (_) (_)
	Exit	() () ()
	Other Damage	
	LOCATION	PHOTO NO.
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		-



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "0"

DATE: 11/18/80 PAGE 15 OF 16

	EVALUATION OF	DATA			
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DATE: 11/18/80 PAGE 16 OF 16

DOCUMENT NUMBER

QTP-2191 SECTION "P"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR FUEL FIRE TEST

REVISIONS					
LTR.	DATE	PREPARED	APPROVED	DESCRIPTION	
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PREPAR	RED BY:	DAT	E:	"Mloti	

Richard Lyman

11/20/80

CHECKED BY:

DATE:

APPROVED BY: DATE:

NO. QTP-2191 Section "P"

DATE: 11/20/80

PAGE

FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

OF 19

1.0 SCOPE

This procedure covers the requirements for Fuel Fire Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 <u>MILITARY SPECIFICATIONS</u>

MIL-T-5629 Turbine fuel, aviation, Grades JP-4 and JP-5.

MIL-STD-831 Preparation of test reports.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78 Tank - 450 gallon external fuel,

filament wound lightweight

explosion proof.

2.3 DRAWINGS

FIBER SCIENCE, INC.

2191-001 Tank - installation, 450 Gallon H-53

SARGENT FLETCHER

27-450-4400 Pylon assembly

450 gallon fuel tank.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 2 OF 19

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3.0 REQUIREMENTS

3.1 <u>TEST ARTICLE</u>

One tank assembly (2191-001) mounted to a pylon (27-450-4400) which in turn is mounted to a test stand shall be fueled to a full tank condition with JP-5 and subjected to a JP-4 fuel fire for 10 minutes as described in Technical Exhibit ASD/ENFEA-78 Paragraph 3.4.1.7.4.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1, with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST METHOD

The tank shall then be filled to the normal full position with JP-5 fuel, suspended in a 2^{0} nose down position by the pylon support points with a suitable test fixture. The tank shall be suspended 48 ± 2 inches at its center point above a reservoir of JP-4 fuel. This reservoir when ignited shall have sufficient fuel to entirely engulf the tank in flames at a minimum temperature of 1750^{0} F. for a minimum of 10 minutes. A 16 mm. full color movie shall be taken of the entire burn test sequence. Refer to Figure 1.

3.4 TEST INSTRUMENTATION

Full color 16 mm movies shall be taken of the burn test from automatic ignition through extinguishing of all flames. The camera shall be positioned so that a side view can be seen and in such a way as to photograph well the extinguishing process without blocking the view of the process. Refer to Figure 2. Continuous temperature reading shall be monitored during the test by 20 thermocouples positioned approximately as shown in Figure 3. Twelve (12) color still photos shall be taken after the fire has been extinguished at select locations as determined by the testing activity and the Fiber Science Test Engineer.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 3 OF 19

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within $\frac{1}{2}$ 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

At the conclusion of testing a test report shall be prepared for submission to the contractor.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 4 OF 19

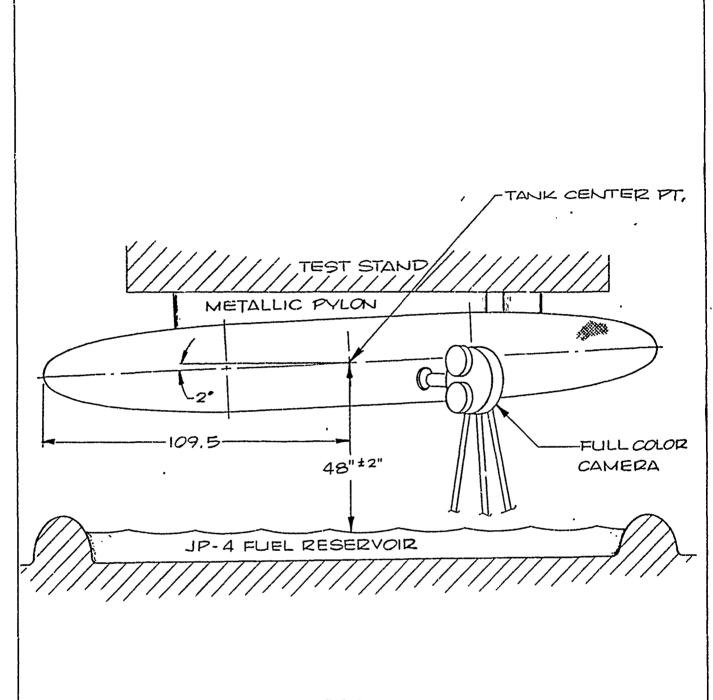


FIGURE 1
BASIC TEST ARRANGEMENT



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 5 OF 19

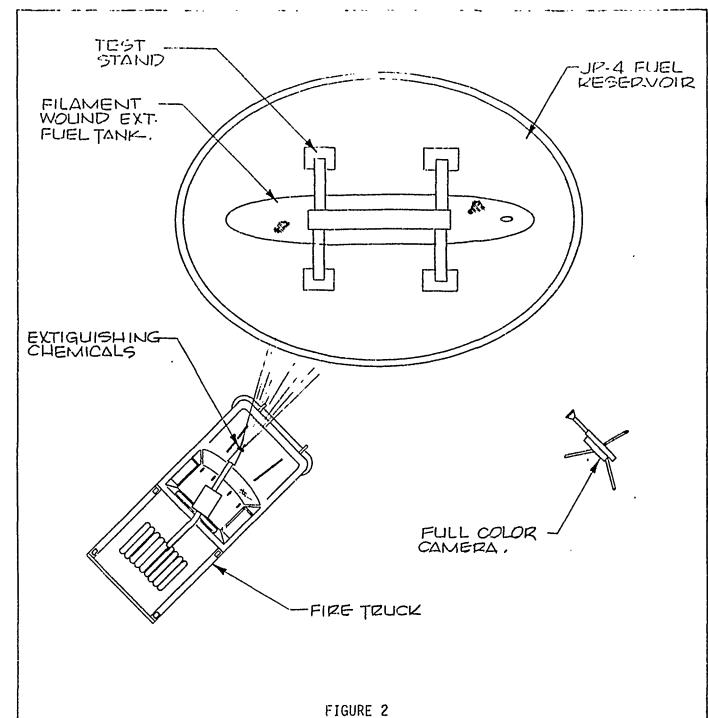


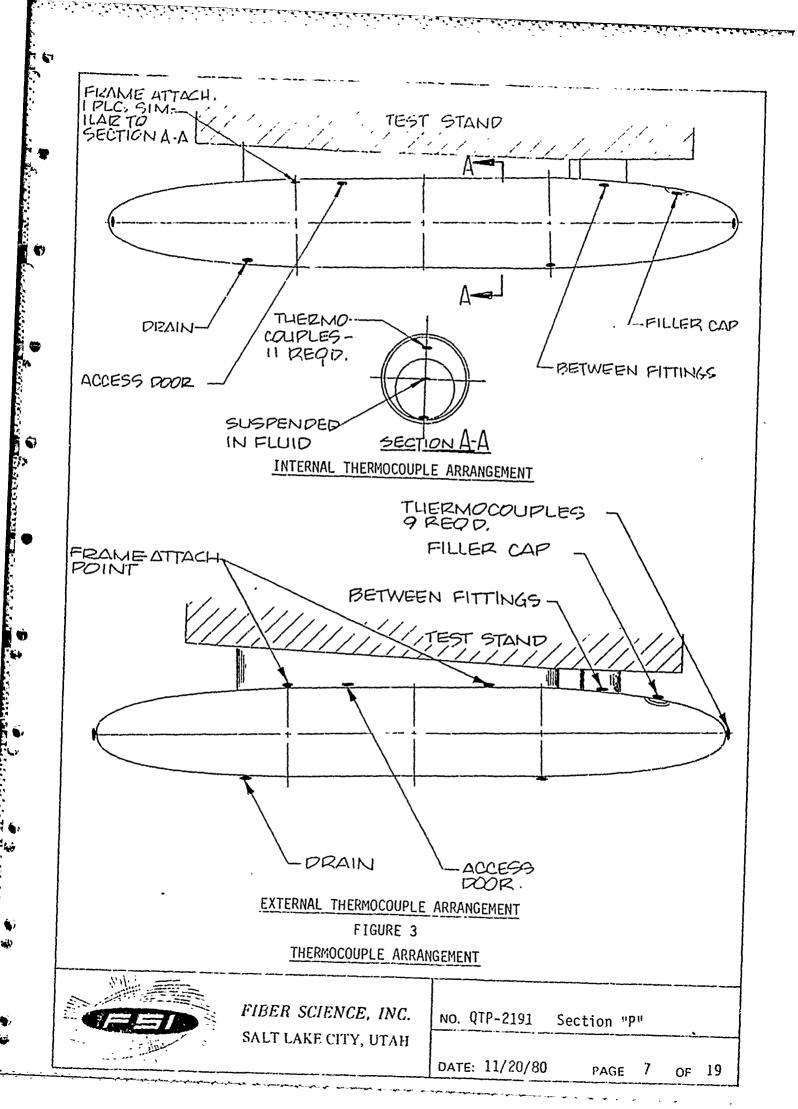
FIGURE 2
EXTINGUISHING FUEL FIRE ARRANGEMENT



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 6 OF 19



4.0 QUALIFICATION TEST PROCEDURE

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the test stand for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 and Figure 2 of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit.

4.4 <u>INSTRUMENTATION</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instrumentation, test equipment, cameras, thermocouples and recorders shall be installed and leads to sensors properly insulated for the test. Temperature readings shall be taken at locations indicated in Figure 3 of this procedure.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 8 OF 19

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 FUELING

The tank shall be filled with 450 to 457 gallons of JP-5 fuel through the filler cap opening. The tank if properly mounted (20 nose down) will contain the proper amount of fuel when the fuel begins to overflow at the filler cap opening.

4.6 <u>FUEL FIRE TEST</u>

With all instrumentation synchronized and ready for operation the reservoir shall be filled with JP-4 fuel to the desired level to complete the test. The fuel shall be remotely ignited and the documentation recorded. The burn time shall be 10 to 10.5 minutes after complete ignition of the reservoir. The extinguishing time shall be recorded and shall be as rapid as is practical but not more than 10 minutes.

4.7 POST FUEL FIRE EXAMINATION

The tank shall complete this test without rupture. Examine entire surface of the tank with special care taken to examine the following:

- Void volume area of the tank.
- b. The various fittings on the tank.
- c. The mounting bolt locations.
- d. Access openings.
- e. Nose and tail caps.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 9 OF 19

Examine and record the condition of the pylon. Twelve (12) color photographs shall be taken of the tank condition at locations determined by the testing activity and Fiber Science Test Engineer. At the discretion of the authorized Fiber Science Test Engineer the tank may be cross sectioned to determine the extent of degradation or damage to inside filament winding on the tank.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per . MIL-STD-831 within thirty days after the testing is complete. This report is to include all recorder temperature data sheets, 16 mm. color movie film, 12 color photographs and the expended tank. The expended tank shall be returned to Fiber Science for postevaluation in the same shipping container it was received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 10 OF 19

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 11 OF 19

TEST DATA SHEET

QTR-2191 SECTION "P"

Testing Activity	Activity Test Engr
Tank Serial No	F.S.I. Test Engr.
Test Date	Government Rep.
	, · · ,
	EXAMINATION OF PRODUCT
Ref. Para. 4.1	Visual Inspection
	Delaminations (Tap Test)
	MOUNTING
Ref. Para 4.2:	Aircraft Simulated Attachment
	Deviations If Any
•	
	FIBER SCIENCE, INC. No. QTP-2191 Section "P"
	SALT LAKE CITY, UTAH

DATE: 11/20/80

PAGE 12 OF 19

	ARRANGEMENT	
Ref. Para. 4.3	Approved Test Arrangement (Ref. Figu	re 2 & ASD/ENFEA-78
	Technical Exhibit.)	
	Testing Activity Approval	
	Approved By	Date
	F.S.I. Test Engineer Approval	
	Approved By	Date
	Government Approval	
	Approved By	Date
	Minimum of two signatures required.	
	INSTRUMENTATION	
Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CALIBRATION	
	ITEM	CALIBRATION DATE
	Igniter If Applicable	
	Cameras If Applicable	
	Thermocouple Recorder	
	Timing Devices	
	Other Instruments:	
	1	
	2	
	3	
	4	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 13 OF 19

	ARRANGEMENT			
Ref. Para. 4.3	Approved Test Arrangement (Re	f. Figure 2 & ASD/ENFEA-78		
	Technical Exhibit.)			
	Testing Activity Approval			
	Approved By	Date		
	F.S.I. Test Engineer Approval			
	Approved ByDate			
	Government Approval			
	Approved By	Date		
Minimum of two signatures required.				
INSTRUMENTATION				

Ref. Para. 4.4.1	•
------------------	---

CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Igniter If Applicable	
Cameras If Applicable	
Thermocouple Recorder	
Timing Devices	
Other Instruments:	Total Control of the
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 13 OF 19

Ref. Para. 4.4.2	CHECK PROPER INSTALLATION	
	ITEM	REMARKS
	Tank/Reservoir	entring and the first program in the services of the control of th
	Camera	
	Thermocouples	The state of the
	Recorders	
	Other Instruments:	
	1.	
	2	
	3	
	4	
Ref. Para. 4.4.3	CHECK PROPER OPERATION	
•	ITEM .	REMARKS
	Igniter	
	Cameras	
	Thermocouples	
	•	
	Recorders	
	Recorders Fire Extinguishing Equipment	
	Recorders Fire Extinguishing Equipment	
	Recorders Fire Extinguishing Equipment Other Instruments: 1	
	Recorders Fire Extinguishing Equipment Other Instruments: 1 2	
	Recorders Fire Extinguishing Equipment Other Instruments: 1	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. Q[P-2191 Section "P"

DATE: 11/20/80 PAGE 14 OF 19

FUEL ING

		
Ref. Para. 4.5:	FUEL TANK AT PROPER ATTI	TUDE
	ITEM	REMARKS
	Attitude (2 ⁰ nose down)	
	Fill With 450 Gal. JP-5	
	Secure Filler Cap	
	Reservoir Filled With	
	Gallons of JP-4	
	FUEL FIRE TEST	
Ref. Para. 4.6	IGNITE JP-4 FUEL FIRE WISYNCHRONIZED	TH ALL INSTRUMENTATION
	ITEM	OPERATION REMARKS
	Igniter	
	Cameras	
	Thermocouples	
	Recorders	
	Fire Extinguishers	
	Timers	
	Other Instruments	
	1.	
	2	
	3.	
	4	
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 15 OF 19

Ref. Para. 4.6	BURN TIME .				
	ITEM	TIME			
	Initial Ignition				
	Complete Reservoir Ignition				
	Begin Extinguishing				
	Extinguishing Complete				
	POST FUEL FIRE EXAMINATION	·			
Ref. Para. 4.7:	EXAMINE TANK FOR THE FOLLOWING:				
	GENERAL APPEARANCE				
	VOID VOLUME REGION				
		*			
	FITTING REGION				
	a. Fuel & Air Fittings				
	b. Drain Fitting				
•					

SALT LAKE CITY, UTAH

DATE: 11/20/80

OF 19

PAGE 16

MOUNTIN	G BOLT LOCATIONS
a.	Forward
b.	Aft
	•
ACCESS	OPENINGS
a.	Forward
•	
b.	Aft
END CLO	SURFS
NOS	e
Tai	1
PYLON C	ONDITION
•	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "P"

DATE: 11/20/80 PAGE 17 OF 19

Ref. Para. 4.8.4	PHOTOGRAPHS				
	Number Photographs and Identify Locations				
	<u>РНОТО</u> <u>LO</u>	CATION	PHOTO	LOCATION	
	1.		7.		
	2.		8.		
	3.		9.		
	4.	وسيوره والأورود والأسراط والثاني وورودون فيكرانا والتراج والإراد	10.	-	
	5.		11.		
	6		12.		
	DISSECTION	OF TANK			
			Date		
	GENERAL INTERIOR CONDITION				
			•		
	CONDITION OF INNER WINDING				
			•		
	CONDITION O	F LINER			
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SALT LAKE CITY, UTAH

QTP-2191 Section "P"

PAGE 18

of 19

NO.

DATE: 11/20/80

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THERMOCOUPLE RECO	ORDINGS:		
GENERAL CONDITION	:		
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	SALT LAKE CITY, UTAH	NO. QTP-2191	Section "P" .

OF 19

PAGE 19

DATE: 11/20/80

DOCUMENT NUMBER

QTP-2191 SECTION "Q"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR ELECTROSTATIC TEST

	REVISIONS				
LTR.	DATE	PREPARED	APPROVED	DESC	CRIPTION
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NO. QTP-2191

DATE: 1/21/81

Section "Q"

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APPROVED BY:
C. a. Vatnuly

DATE:

.. 1/30/81

SALT LAKE CITY, UTAH

PAGE 1

OF 19

1.	O	SCOPE

This procedure covers the requirements for Electrostatic Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831

Test Reports, Preparation of.

2.2 FEDERAL SPECIFICATIONS

FED. TEST METHOD STD. 101B

Preservation, Packaging and Packing Materials; Test

Procedures for.

(METHOD 4046)

(Electrostatic Properties

of Materials)

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78

Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.4 DRAWINGS

FIBER SCIENCE

2191-001

Tank - Installation, 450 gallon H-53

ESD

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 2 OF 19

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One (1) expended tank assembly shall be dissected to remove a minimum of nine (9) structurally sound representative samples for electrostatic discharge testing to the requirements of Paragraph 4.6.23 of the Technical Exhibit ASD/ENFEA-78.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate an actual condition.

3.3 TEST SAMPLES

A minimum of nine (9) structurally sound samples five (5) inches by three (3) inches free from defects such as holes, cracks, or tears shall be prepared for testing. The exterior paint coating must be continuous.

3.4 CONDITIONING

Prior to testing, a minimum of three (3) or one third (1/3) of the samples shall be dried in an oven for twelve (12) days at ... $^{160^{\circ}}$ $^{\circ}$ $^{\circ}$ $^{\circ}$ $^{\circ}$ $^{\circ}$ F. A minimum of three (3) other samples shall be placed in a horizontal position under a continuous water shower for 24 hours. The remaining samples (minimum of 3) shall be placed in a 50 $^{\circ}$ 5% relative humidity atmosphere uniformly maintained at 73° $^{\circ}$ $^{\circ}$ F for twelve (12) days. Upon completion of the individual sample conditioning, all samples shall be dried in a desiccating chamber for a minimum of 24 hours before testing.

3.5 TEST METHOD

The representative test samples properly conditioned shall be electrostatically discharge tested to the requirements of Federal Test Method Standard 101B Method 4046. The maximum decay time for a full charge shall not exceed two (2) seconds.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 · PAGE 3 OF 19

3.6 TEST INSTRUMENT ION

The electrostatic discharge test shall be conducted in a test chamber similar to that shown in Figure 1 using 0 to 15 KV positive and negative power source. Additional instrumentation shall include an electrometer for measuring volts, amperes and ohms from .01 to 100, a single channel recorder capable of recording up to eight (8) inches per second and a still camera for recording at least one color photograph of each test.

3.6.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.7 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.8 <u>DOCUMENTATION</u>

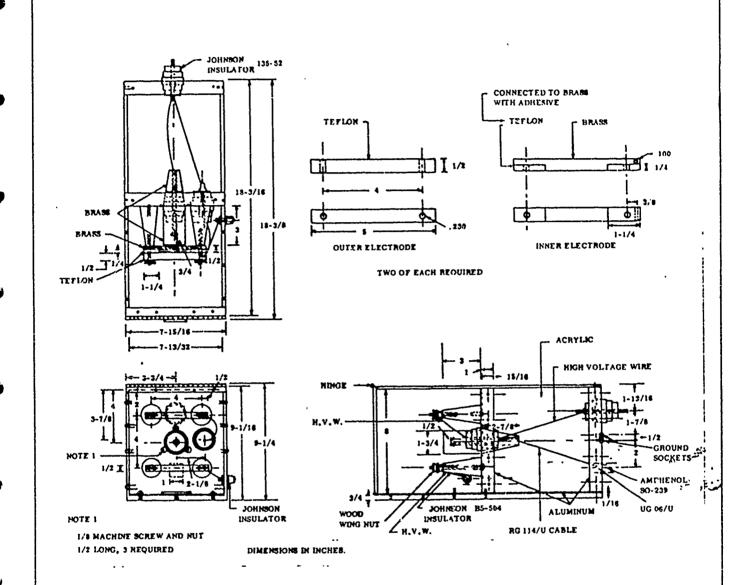
At the conclusion of testing a test report will be prepared for submission to the contractor.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO.QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 4 OF 19



Note: Drawing taken from Federal Test Method Standard 101B Method 4046

FIGURE 1

ELECTROSTATIC TEST CHAMBER MECHANISM



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 · PAGE 5 OF 19

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF SAMPLES

The test samples prepared to the requirements of Paragraph 3.3 by Fiber Science, Inc., shall be fully examined prior to conditioning for use in the test chamber for shipping damage to the test facility. This examination shall include a visual inspection per Paragraph 3.3 and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 CONDITIONING OF SAMPLES

Condition the test samples to the requirements of Paragraph 3.4 and Federal Test Method Standard 101B Method 4046. The time sequence of the conditioning shall be such that upon completion of the conditioning all samples will be ready to test on the same day.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure, applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and Federal Test Method Standard 101B Method 4046.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 <u>INSTALLATION</u>

All instruments and test equipment: electrostatic discharge device, electrometers, recorders and camera shall be installed and synchronized in such a way as to best satisfy the intent of the test.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 6 OF 19

4.: ? OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 <u>ELECTROSTATIC DISCHARGE TEST</u>

With all samples properly conditioned and all instrumentation synchronized and ready for operation, insert individually each sample into the electrostatic discharge chamber and apply a static discharge per Paragraph 6 of Federal Test Method Standard 101B Method 4046. The maximum electrostatic discharge decay time shall not exceed two (2) seconds on any of the sample tests.

5.0 QUALIFICATION REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all electrostatic discharge decay time recorder data sheets, applied static discharge voltages and photographs. The test samples shall be returned to Fiber Science in the same shipping container it was received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 7 OF 19

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 · PAGE 8 OF 19

TEST DATA SHEET

QTR-2191 SECTION "Q"

Testing Activity	Activity Test Engr
Tank Serial No	F.S.I. Test Engr.
Test Date	Government Rep.
	EXAMINATION OF SAMPLES
Ref. Para 4.1:	Visual Inspection
	Delaminations (Tap Test)



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81

PAGE 9

OF 19

CONDITIONING OF SAMPLES

Ref. Para. 4.2:	CONDITION SAMPLES FOR ELECTR	ROSTATIC DISCHARGE TESTING
	Samples oven dried at 1600 tdays. Three (3) samples mir	5 ⁰ F for twelve (12) nimum required.
	ITEM	REMARKS
	Number of Samples	
	Date and Time in Oven	
	Date and Time out of Oven	
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81

PAGE 10 OF 19

Ref. Para. 4.2:	CONDITION SAMPLES FOR ELECTROSTATIC DISCHARGE TESTING - (continued)
	Samples placed in water shower for 24 hours. Three (3) samples minimum required.
	<u>ITEM</u> REMARKS
	Number of Samples
	Date and Time in Shower
	Date and Time out of Shower
	Visual Inspection of Condition
	Delaminations (Tap Test)
	Samples placed in 50 \pm 5% relative humidity at 730 \pm 50 F for twelve (12) days.
	<u>ITEM</u> <u>REMARKS</u>
	Number of Samples
	Date and Time in 50% Humidity
•	Date and Time out of 50% Humidity



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 11 OF 19

	TESTING - (continued)	LECTROSTATIC DISCHARGE
		ndition
	Delaminations (Tap Test	
	All samples (after cond chamber for 24 hours be	itioning) placed in desiccating fore testing.
	ITEM	REMARKS
	Number of Samples	
	Date and Time in Chamber	
	Chamber Condition	
	Date and Time Out of Cha	amber
	Visual Inspection of Con	ndition
	Delaminations (Tap Test	

DATE: 1/21/81

PAGE 12

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ARRANGEMENT

Ref. Para. 4.3:	APPROVED TEST ARRANGEMENT (REF. TECHNICAL EXHIBIT AND FED. TEST METHOD 4046).	FIGURE 1, ASD/ENFEA-78 METHOD STD. 101B
	Testing Activity Approval	
	Approved By	Date
	F.S.I. Test Engineer Approval	
	Approved By	Date
	Government Approval	
	Approved By	Date
	Minimum of two signatures require	ed.
	. <u>INSTRUMENTATION</u>	
Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CALIBRATION	<u>N</u>
	ITEM	CALIBRATION DATE
	Electrostatic Discharge Mech (If Applicable)	17 192
	Cameras (If Applicable)	
	Electrometers	
	Discharge Decay Recorder	
	Other Instruments:	MI SETTITURE SELECTION OF SELECTION CONTRACTOR OF SECURITY AND SECURITY OF SECURITY
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	2	territorio di distributo più coltre di Latte di Inggano ao consiste di la consegnito di la composizioni e ca coltributo della
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DATE: 1/21/81 PAGE 13 OF 19

Ref. Para. 4.4.2:	CHECK PROPER INSTALLATION	
	ITEM	REMARKS
	Electrostatic Discharge Mechanism	
	Cameras	
	Electrometer	1970 1971 kilitir Minamakin pumpi Sanigagapa, Alikumphysi akk 1994 inga ang Min-Ministry pumpinistis k
	Discharge Delay Recorders	
	Other Instruments:	
	1.	
	2.	
Ref. Para. 4.4.3:	CHECK PROPER OPERATION	
	ITEM	REMARKS
	Electrostatic Discharge Mechanism	
	Cameras	
	Electrometer	
	Discharge Delay Recorders	
	Other Instruments	
	1.	
		12-12-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1
•		
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FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 . PAGE 14 OF 19

ELECTROSTATIC DISCHARGE TEST

Ref. Para. 4.5:	CALIBRATION	
	5 KV Positive charged voltage Calibration Panel	applied to Aluminum
	ITEM	REMARKS
	Electrometer Multiplier Switch at 10	
	Discharge Mechanism Operate Switch at O	
	Recorder Chart Speed at one (1) inch/second	
	Close High Voltage (5 KV) Positive Switch	
	Adjust Multiplier Switch to Maximum	
	Multiplier Charge equal to Recorder Chart Reading	
	Close Discharge Mechanism Ground Switch	
	Stop Chart Recorder at zero Electrometer Reading	عمر غو خو
	Electrometer Zero Check Position	
	Measure Discharge Decay Time	
	EVALUATION:	
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NO. QTP-2191

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Section "Q"

PAGE 15

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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 PAGE 16 OF 19

Ref. Para. 4.5:	SAMPLE DISCHARGE TEST	
	5 KV Positive and Negative characteristics to the test samples.	arged voltages applied
	ITEM	REMARKS
	Electrometer Multiplier Switch at 10	
	Operate Switch at O	
	Recorder Chart Speed at one half (1/2) inch/second	
	Vertical Sample Between Electrodes	
	Close High Voltage Switch (5 KV Positive 5 KV Negative)	
. .	Adjust Multiplier Switch to Maximum	
	Close Grounding Switch	

Measure Discharge Decay Time



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "Q"

DATE: 1/21/81 · PAGE 17 OF 19

	EVALUATION OF	DATA		
ENERAL APPEARAI	NCE OF TESTED SAMPLES:			
			-	- ,
			······································	
				
LECTROSTATIC DI	ISCHARGE DECAY TIME:			
			······································	
_ECTROSTATIC CH	HARGE OF SAMPLES RELATIVE	TO OTHER SIMILAR	USE MATERIALS:	
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	FIBER SCIENCE, INC. SALT LAKE CITY, UTAH	NO. QTP-2191	Section "Q"	OF 15

DOCUMENT NUMBER

QTP-219' SECTION "R"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR LIGHTNING TEST

			REVISIONS
LTR. DATE	PREPARED	APPROVED	DESCRIPTION
			مند: ،
PREPARED BY:	DATE		
Richard Lyman CHECKED BY:	DATE	/29/80 	FIBER SCIENCE, INC. SALT LAKE CITY, UTAH
Tandy STA	DATE	(5/80	NO. QTP - 2191 Section "R"
C.a. Pal.	mle J. 1/8	181	DATE: 11/29/80 PACE : 0119

1.0	SCOPE	
	Inis procedure covers the requirements for Lightning Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.	
2.0	APPLICABLE DOCUMENTS	
2.1	MILITARY SPECIFICATIONS	
	MIL-B-5087	Electrical bonding and lightning protection for aerospace systems.
	MIL-STD-831	Preparation of test reports.
2.2	FEDERAL SPECIFICATIONS	
	FAA-Circular 20-53	Prevention of fire and explosion from lightning strike.
2.3	TECHNICAL EXHIBIT	
	ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound lightweight explosion proof.
2.4	TECHNICAL REPORTS	
	SAE Committee AE4L	Lightning Test Waveforms and Techniques for Aerospace Vehicles and Hardware.
2.5	DRAWINGS	
	FIBER SCIENCE	
	2191-001	Tank - installation, 450 gallon H-53
	- SARGENT FLETCHER	
	27-450-4400	Pylon assembly 450 gallon fuel tank.
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SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 2 OF 19

3.0 REQUIREMENTS

3.1 TEST ARTICLE

Two (2) test articles, one sub scale and one full scale, shall be subjected to a simulated lightning strike as described in Technical Exhibit ASD/ENFEA-78 Paragraph 3.8.6 and verified in accordance with the requirements of MIL-B-5087 to the extent applicable.

3.1.1 SUB SCALE TEST ARTICLE

One (1) test article shall be a scale model of the full scale test tank and shall be used in simulated lightning tests to establish lightning characteristics relative to possible attachment points for Zone 1A areas (direct attachment areas) and Zone 1B areas (channel hang-on areas).

3.1.2 FULL SCALE TEST ARTICLE

One (1) full scale pre-production tank assembly (2191-001) mounted to a pylon (27-450-4400) which in turn is mounted to a test fixture shall be placed in a high current lightning test area. The tank shall then be subjected to simulated lightning strikes in the areas determined by the simulated testing of the scale model of paragraph 3.1.1.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 2 and Figure 3 for the sub scale and full scale tests respectively. All reasonable precautions shall be taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST METHOD

An initial paper study shall be made of the composite tank design (see Drawing 2191-001) taking particular note of the proper grounding of any concentration of metallic or conductive parts to the tank pylon and aircraft. In addition the tank shape and location on the H-53 helicopter shall be made to determine the most likely areas (Zone 1A) for direct lightning strike attachment (see Figure 1). Secondary, channel hang-on areas (Zone 1B) shall also be determined



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 3 OF 19

prior to testing. This study shall be made by a qualified lightning research authority who is to be selected by the testing activity and approved by the Fiber Science Test Engineer and a Government representative.

3.3.1 SUB SCALE TEST METHOD

The sub scale test article of Paragraph 3.1.1 shall be placed in a high current lightning test area. An adequate current ground path and return to generator path shall be established as part of the test setup. The sub scale test article shall be struck with a simulated direct lightning strike of 200,000 amperes at all points determined to be possible direct attachment points from the paper study of Paragraph 3.3. The sub scale test article shall be empty, dry and loaded with a spark detecting device, preferably an open lense camera.

3.3.2 FULL SCALE TEST METHOD

One empty and dry tank assembly (2191-001) mounted to a pylon (27-450-4400) which in turn is mounted to a functional test fixture by means of a TF-261-178 adaptor shall be placed in a high current lightning test area. An adequate current ground path and return to generator path shall be established as part of the test setup. The pylon ejection gun shall be loaded with 2 cartridges, the breach shall be closed and the triggering mechanism shall be placed in a normal flight position. The tank shall then be struck with a simulated direct lightning strike of 200,000 amperes at all points determined to be possible direct attachment points from studies and tests performed in Paragraphs 3.3 and 3.3.1.

3.4 TEST INSTRUMENTATION

High speed full color movies shall be taken with a Fast-X camera capable of photographing 4000 frames per second minimum at the time the tank is struck with the simulated lightning strike. Pressure in the tank during the time interval of the impact transient shall be measured and recorded at four points as shown in Figure 3. One color still photo shall be taken of each simulated lightning strike point and any areas damaged by channel hang-on effects.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 4 OF 19

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

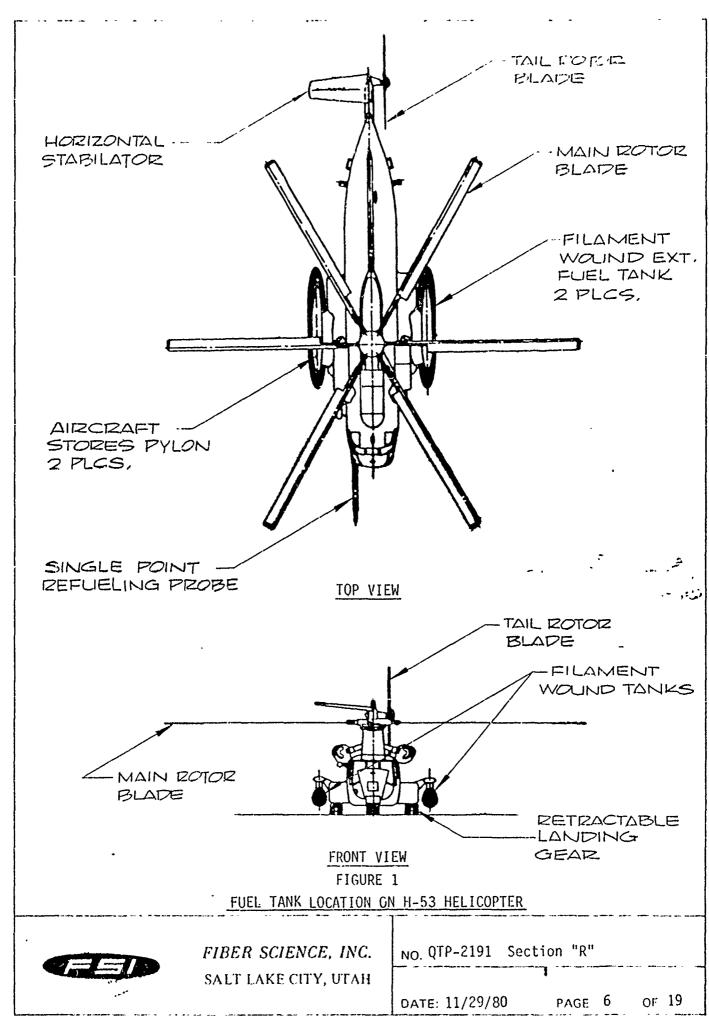
At the conclusion of testing a test report will be prepared for submission to the contractor.

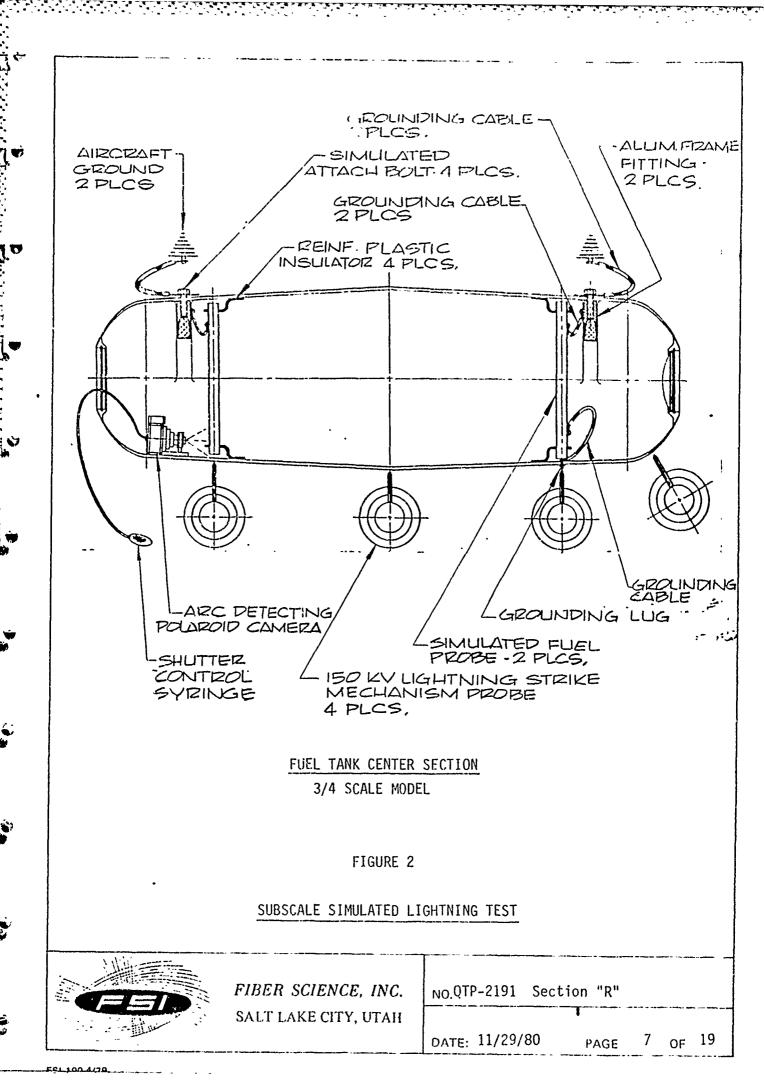


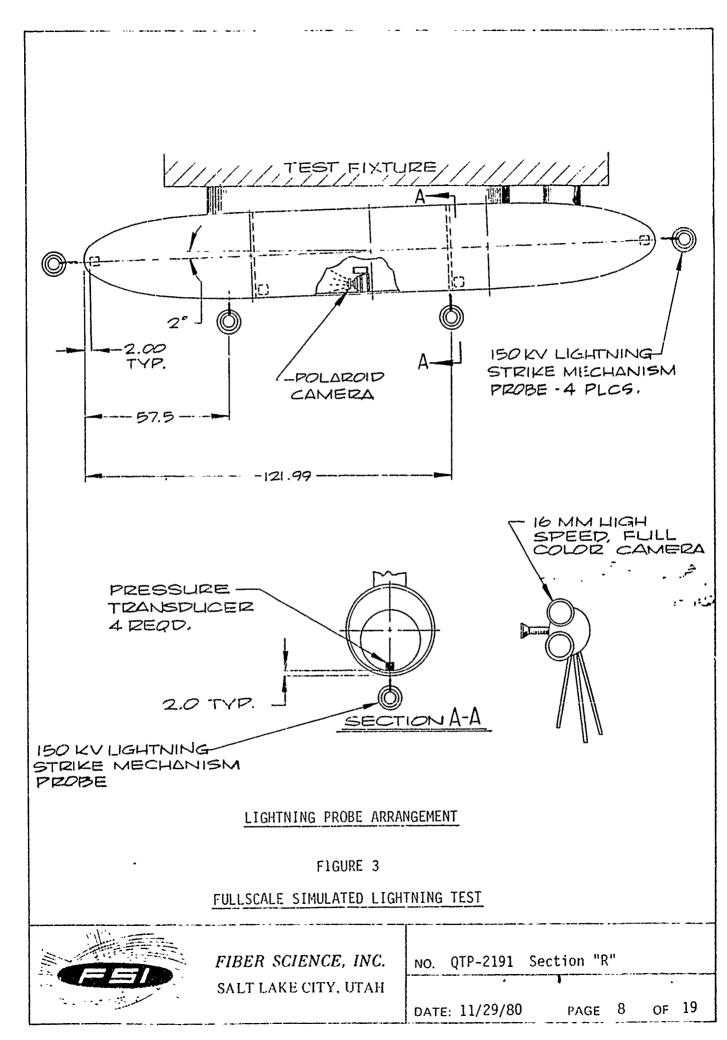
FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 5 OF 19







4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The sub scale test article and the pre-production test tank and pylon shall be fully examined prior to mounting to the test stand for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The sub scale test article and the pre-production test tank shall then be mounted to the test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 2 (sub scale test article) and Figure 3 (pre-production test tank) of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and MIL-B-5087.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last three months.

4.4.2 INSTALLATION

All instruments and test equipment: current generators, lightning strike mechanism, volt meters, amp meters, cameras, pressure transducers, and recorders shall be installed in such a way as to best satisfy the intent of the test. Pressure readings shall be taken at locations indicated in Figure 3 of this procedure.

NOTE: Pressure readings or 16 mm. movie camera shall not be required on sub scale lightning test.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 9 OF 19

FSI-100-4/79

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 STRIKE LOCATIONS

The lightning strike attachment locations for the sub scale test article shall be determined by the Fiber Science Test Engineer after a thorough review of the paper study required per Paragraph 3.3 (Test Method), in consultation with the testing activity test engineer, and approved by an authorized Government representative. The lightning strike locations for the full scale pre-production tank and pylon shall be determined in the same manner as the sub scale test article except the test report and test data of the sub scale test article testing shall be reviewed to best establish the lightning strike attachment locations.

4.6 GUN LOADING

The ejection gun cartridge chamber shall be loaded with 2 cartridges using a standard load. Safety precautions should taken to insure load is properly installed and that the breach is properly closed and locked.

NOTE: The sub scale test tank shall not be mounted to a pylon and therefore is not affected by this test condition.

4.7 SIMULATED LIGHTNING STRIKE

With all instrumentation synchronized and ready for operation, and the tank pressurized to the operating pressure of 15 psi per Paragraph 3.4.1.3.4 of the Technical Exhibit ASD/ENFEA-78, a simulated lightning strike of 200,000 amps shall be discharged at a pre determined location per Paragraph 4.5. The test shall be repeated for all Zone 1A attachment areas with a post examination per Paragraph 4.8 after each simulated lightning strike.

NOTE: The sub scale test article shall not be pressurized for this test.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 10 OF 19

4.8 POST SIMULATED LIGHTING STRIKE EXAMINATION

The test article shall be examined after each simulated lighting strike for punctures through the composite wall, delaminations to the composite structure, and/or arching inside the test article cavity. As part of the check for delaminations, a tap test shall be made after each test of the entire outside surface of the test article and all delaminations if any shall be accurately located and a sketch made of their approximate size and shape.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report of the lightening tests, shall be submitted per MIL-STD-831 within thirty days after the testing is complete. This report is to include all recorder amprage (if applicable) voltage (if applicable) and pressure data sheets, high speed film, photographs and expended tanks. Expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 11 OF 19

4.8 POST SIMULATED LIGHTNING STYLKE EXAMINATION

The test article shall be examined after each simulated lightning strike for punctures through the composite wall, delaminations to the composite structure, and/or arching inside the test article cavity. As part of the check for delaminations, a tap test shall be made of the entire outside surface of the test article and all delaminations shall be accurately located and a sketch made of their approximate size and shape.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within thirty days after the testing is complete. This report is to include all recorder pressure data sheets, high speed film, photographs and expended tanks. Expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 12 OF 19

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 12 OF 19

TEST DATA SHEET

QTR-2191 SECTION "R"

Testing Activity_	Act	ivity Test Engr	
Tank Serial No.		.I. Test Engr.	
Test Date	Gov	ernment Rep.	
	EXAMINATION OF P	RODUCT	
Ref. Para. 4.1			
	Delaminations (Tap Tes	t)	
			: ِ
	MOUNTING		
Ref. Para 4.2	Aircraft Simulated Attachment		
	Deviations If Any		
•			
			-
	FIBER SCIENCE, INC. SALT LAKE CITY, UTAH	NO. QTP-2191 Section "R"	
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	ARRANGEMENT	
Ref. Para. 4.3	Approved Test Arrangement (Ref. Frechnical Exhibit).	igure 1 & ASD/ENFEA-78
	Testing Activity Approval	
	Approved By	Date
	F.S.I. Test Engineer Approval	
	Approved By	Date
	Government Approval	
	Approved By	Date
	Minimum of two signatures required	
	·	
	INSTRUMENTATION	
Ref. Para. 4.4.1	CHECK INSTRUMENTATION CALIBRATION	
	ITEM	CALIBRATION DATE
	Lightning Strike Mechanism (If Applicable)	، بخصر
	Cameras (If Applicable)	
	Volt Meters	
	Amp Meters	
	Pressure Transducer Recorder	
	Current Recorder	
	Other Instruments:	
	1	
•	2	
	3.	
	4.	
		191 Section "R"
	SALT LAKE CITY, UTAH	

DATE: 11/29/80 PAGE 14 OF 19

Ref. Para. 4.4.2	CHECK PROPER INSTALLATION	
	ITEM	REMARKS
	Cameras	
	Volt Maters	
	Amn Matars	
	Pressure Transducers	
	Pacandans	
	Other Instruments.	
	1	
	2.	
	3	
	4	
Ref. Para 4.4.3	CHECK PROPER OPERATION	1
	ITEM	REMARKS -
	Lightning Strike Mechanism	
	Cameras	
	Volt Meter	
	Amp Meter	
	Pressure Transducers	
	Recorders	
	Other Instruments:	
	2	
	3	

PAGE 15 OF 19

DATE: 11/29/80

STRIKE LOCATIONS

Ref. Para. 4.5:	SELECT LIGHTNING STRIKE AT	TACHMENT
	STRIKE NUMBER	LOCATIONS
	1.	
		-
	GOVERNMENT APPROVAL OF STR	IKE LOCATIONS
	APPROVED BY	Date
	GUN LOADING	•
Ref. Para. 4.6:	LOAD EJECTION GUN WITH 2 S	TANDARD LOAD CARTRIDGES
	ITEM	REMARKS
	Cartridge Load	:- ; :
	Install Cartridges	
	Check Installation	
	Close and lock Breach	territorium distributura a como de Maldelan encommercar e encompagna un appropriama accide un paparama



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 16 OF 19

SIMULATED LIGHTNING STRIKE

	ma magnitude in a revision	ATTITUDE OF THE STATE OF THE ST			
Ref. Para. 4.7:	SIMULATE LIGHTNING STRIKE WITH ALL INSTRUMENTATION SYNCHRONIZED AND TANK PRESSURIZED TO 15 P.S.I.				
	<u>ITEM</u>	OPERATION REMARKS			
	Lightning Strike Mecha	nism			
	Ejection Gun (Shall not discharge)				
	Cameras				
	Volt Meters				
	Amp Meters				
	Pressure Transducers				
	Recorders				
	Other Instruments:				
	1.				
	2.				
	3.				
	4.				
	DOCT CIMINATED LIC	رة, ~: NOTAC STRIVE EVANIANTION			
D C D - 4 0	POST SIMULATED LIGHTNING STRIKE EXAMINATION				
Ref. Para. 4.8	EXAMINE TANK FOR THE FOLLOWING:				
	EJECTION DAMAGE (IF EJ	ECTED)			
	PUNCTURES (IF ANY) State size, appearance and location				
	out of the period and				
•					
	FIBER SCIENCE, INC.	NO. QTP-2191 Section "R"			
	SALT LAKE CITY, UTAH	•			

DATE: 11/29/80 · PAGE 17 OF

19

ESI 100 4479

Results of Tap	Test for delaminations
	sketch of size, location and approximate
PHOTOGRAPHS Number photogra	aphs and identify location
РНОТО	LOCATION
1	
5	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "R"

DATE: 11/29/80 PAGE 18 OF 19

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	EVALUATION OF	DATA		
CAMERAS:				-
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		7-		<u>.</u>
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		The second s		
STRAIN RECORDINGS:				

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	SALT LAKE CITY, UTAH	DATE: 11/29/80	PAGE 19	OF

DOCUMENT NUMBER

QTP-2191 SECTION "S"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR CRASH IMPACT TEST

				REVISIONS
LTR.	DATE	PREPARED	APPROVED	DESCRIPTION
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		<u>.</u>		
	1			
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	Vindes -	Store	12/5/80	NO. QTP-2191 Section"S"
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1.0 SCOPE

This procedure covers the requirements for crash impact testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831 Test Reports, Preparation of.

2.2 <u>TECHNICAL EXHIBIT</u>

ASD/ENFEA-78

Tank - 450 gallon external fuel, filament wound lightweight explosion proof.

2.3 <u>DRAWINGS</u>

FIBER SCIENCE

2191-001 Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400 Pylon Assembly - 450 gallon fuel tank.

FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QIP-2191 Section "S"

DATE: 11/20/80 PAGE 2 OF 21

501 100 4/70

3.0 REQUIREMENTS

3.1 TEST ARTICLES

Two tank assemblies (2191-001) fueled to a full tank condition and mounted to a pylon (27-450-4400) which in turn is mounted to a portable rig shall be subjected to the impact of an aerial drop as described in Technical Exhibit ASD/ENFEA-78. Paragraph 3.4.1.7.5.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Concept A or B of Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter. Other concepts of dropping the tank may be recommended but must be approved before use.

3.3 TEST METHOD

The tanks shall be filled to the normal full position with water and suspended in a 2° nose down position by the pylon support points and secured to the portable test fixture. The tank shall then be dropped for ground impact testing with a forward impact velocity of 39.2 ± 2 feet per second (45 ± 2 feet per second with fuel) and a vertical velocity of 35.3 ± 2 feet per second (40 ± 2 feet per second with fuel), see Figure 2. The impact angle of the tank with respect to the ground shall be between 0° and 15° nose up. Refer to Figure 2. Total allowable leakage is .25 gallons per minute maximum for this test.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE. 11/20/80 PAGE 3 OF 21

3.4 TEST INSTRUMENTATION

High speed full color movies shall be taken with a 16 mm. camera capable of photographing 1000 frames per second minimum at the time of impact. Pressure in the tank during the time interval of the impact transient shall be measured and recorded at four points as shown in Figure 3. Ten (10) biaxial strain gauges, as shown in Figure 3, shall also be attached to record tank structural loading during the test. Twelve (12) color still photos shall be taken of the impact damaged areas and any other highly stressed or failed areas after the test.

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with paragraph 4 of this document.

3.6 DOCUMENTATION

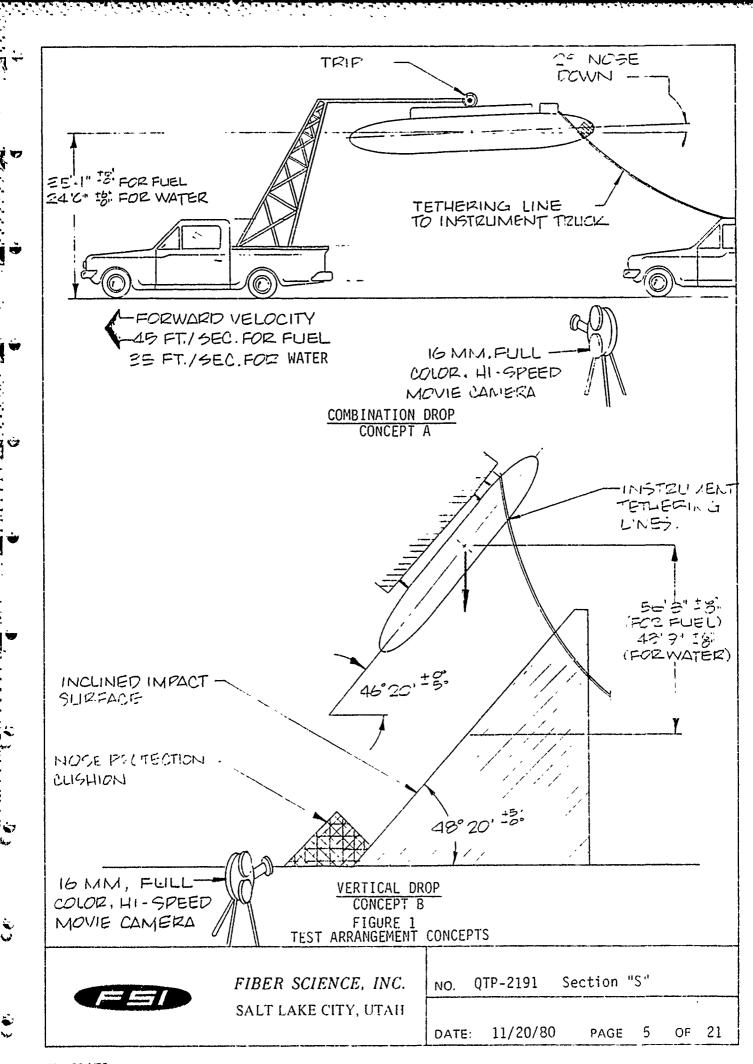
At the conclusion of testing a test report will be prepared for submission to the contractor.



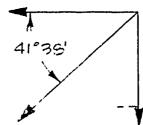
FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO QTP-2191 Section "S"

DATE: 11/20/80 PAGE 4 OF 21



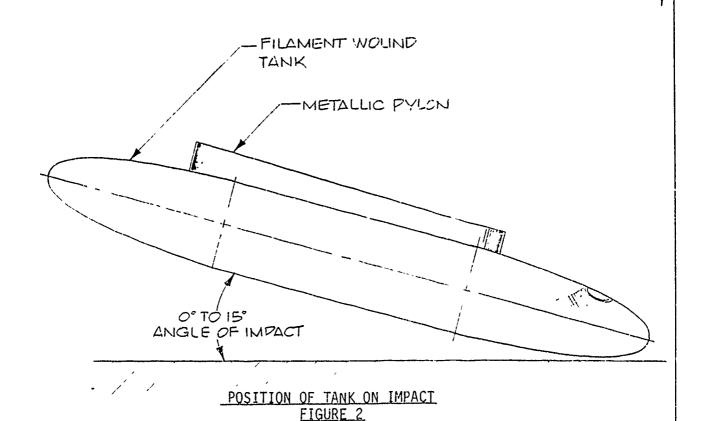
Forward tank velocity component with fuel 45 ± 2 feet per second. Equivalent forward tank velocity component with water 39.6 ± 2 feet per second



Vertical tank velocity component with fuel 40 \pm 2 feet per second. Equivalent vertical tank velocity component with water 35.3 \pm 2 feet per second.

Resultant tank velocity component with fuel 60.2 \pm 2 feet per second. Equivalent resultant tank velocity component with water 53.1 \pm 2 feet per second.

VECTOR DIAGRAM OF TANK IMPACT VELOCITY



CRASH IMPACT CONDITIONS



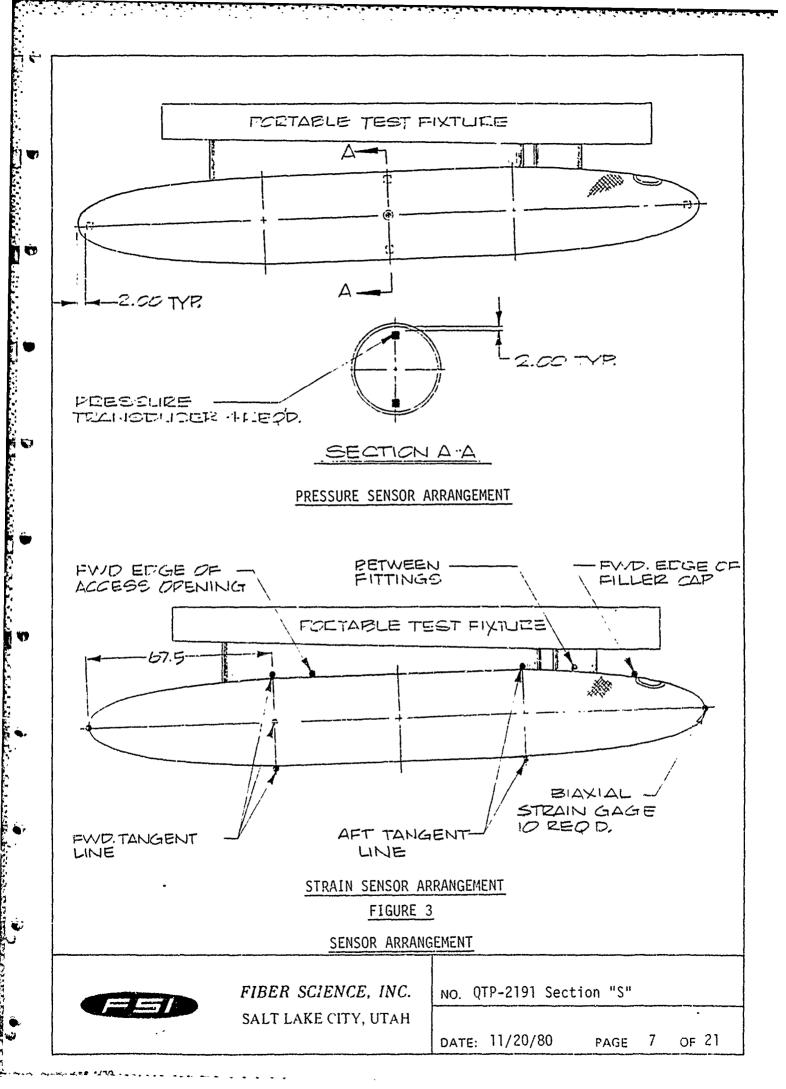
FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE. 11/20/80

PAGE 6

OF 21



4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the portable test rig for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank shall then be mounted to the portable test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure I of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an F.S.I. authorized test engineer and an authorized Government representative.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrumentation has had a calibration check within the last calibration period.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE 11/20/80

PAGE 8 ' OF 21

4.4.2 <u>INSTALLATION</u>

All instruments and test equipment: velocity meters, cameras, pressure transducers, strain gauges and recorders shall be installed and leads properly tethered so as to have little or no affect on the test. Pressure and strain readings shall be taken at locations indicated in Figure 3 of this procedure.

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 FUELING

The tank shall be filled with 450 to 457 gallons of water through the filler cap opening. The tank properly mounted (20 nose down) during filling will contain the proper amount when the water begins to overflow out the filler cap opening.

4.6 CRASH IMPACT

With all instrumentation synchronized and ready for operation, the tank shall be dropped at the proper speed and angle.

4.7 POST CRASH IMPACT EXAMINATION

4.7.1 LEAKAGE

All leakage from the tank shall be measured where practical. The combined leakage from all ruptures shall not exceed .25 gallons per minute maximum.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80 PAGE 9 OF 21

4.7.2 RUPTURES

All tank ruptures shall be properly described and accurately located on the tank surface. The exact size of the rupture (width, length and depth where applicable) shall be noted.

4.7.3 NON-RUPTURE DAMAGE

All other damage to the tank surface or fittings shall be recorded including exact location and size.

4.7.4 DELAMINATIONS

The entire tank surface shall receive a tap test to determine if any delaminations occurred outside the impact area. A sketch shall be made showing approximate size and shape.

4.7.5 CRASH IMPACT IMPRINT

The tank impact surface imprint configuration shall be graphically sketched and dimensioned.

4.7.6 PHOTOGRAPHS

At least twelve (12) color photographs of the damaged areas at locations determined by the testing activity and the Fiber Science Test Engineer shall be taken.

4.7.7 <u>DISSECTION</u>

At the discretion of the authorized Fiber Science Test Engineer, the tank may be cross sectioned to determine the internal extent of the crash impact damage.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80 PAGE 10 OF 21

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5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded pressure and strain data sheets, high speed film, photographs and expended tanks. Expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80 PAGE 11 OF 21

ERI 100 4/70

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80 PAGE 12 OF 21

TEST DATA SHEET

QTR-2191 SECTION "S"

Tank Serial No	Activity Test Engr F.S.I. Test Engr Government Rep.
Ref. Para. 4.1:	EXAMINATION OF PRODUCT Visual Inspection
	Delaminations (Tap Test)
Ref. Para. 4.2:	MOUNTING Aircraft Simulated Attachment Deviations If Any
	FIBER SCIENCE, INC. NO. QTP-2191 Section "S" SALT LAKE CITY, UTAH

DATE: 11/20/80 PAGE 13

OF 21

	ARRANGEMENT	
Ref. Para. 4.3:	Approved Test Arrangement (Ref. Figu	re 1 & ASD/ENFEA-78
	Technical Exhibit.)	
	Testing Activity Approval	
	Approved By	Date
	F.S.I. Test Engineer Approval	
	Approved By	Date
	Government Approval	
	Approved By	Date
	Minimum of two signatures required.	
	INSTRUMENTATION	
Ref. Para. 4.4.1:	CHECK INSTRUMENTATION CALIBRATION	
	ITEM	CALIBRATION DATE
	Speedometer (If applicable)	
	Cameras (If applicable)	·
	Pressure Transducer Recorder	
	Strain Gauge Recorder	
	Other Instruments	
	1	
	2	
	3	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80 PAGE 14 OF 21

Daf Dava 4 4 9	CUTCU DOODED INCTALLATION	
Ref. Para. 4.4.2:	CHECK PROPER INSTALLATION	•
A	ITEM	REMARKS
	Tank	
	Speedometers	
	Cameras	
	Pressure Transducers	
	Strain Gauges	
	Recorders	
	Other Instruments	
	1	
Ref. Para 4.4.3:	CHECK PROPER OPERATION	
	ITEM	<u>REMARKS</u>
	Speedometers	
	Trip Mechanism	
	Cameras	
	Pressure Transducers	
	Recorders	
	Other Instruments	
	1.	
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•		
	4.	
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DATE: 11/20/80 PAGE 15 OF 21

	FUELING	
Ref. Para 4.5:	FUEL TANK AT PROPER ATTITU	JDE_
	1TEM	REMARKS
	Attitude (2 ⁰ Nose Down)	
	Fill with 450 Gal. Water	
	Secure Filler Cap	
	CRASH IMPACT TE	<u>ST</u>
Ref. Para. 4.6:	DROP TANK WITH ALL INSTRU	MENTATION SYNCHRONIZED
	ITEM	OPERATION REMARKS
	Speedometers	
	Trip Mechanism	
	Cameras	
	Pressure Transducers	
	Strain Gauges	
	Recorders	
	Other Instruments	
	1.	
	2	
	3.	
	4.	



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH NO. QTP-2191 Section "S"

DATE: 11/20/80 OF 21 PAGE 16

	POST CRASH IMPACT EXAMINATION
Ref. Para. 4.7:	General Appearance
Ref. Para. 4.7.1:	<u>LEAKAGE</u>
	Amount At Each Location
	1.
	2
	3.
Ref. Para. 4.7.2:	4
кет. Para. 4.7.2:	RUPTURES
	Locations
	1
	3.
	Extent of Damage
	1.
	2.
	3.
	4.
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE. 11/20/80 PAGE 17 OF 21

Ref. Para. 4.7.3	NON-RUPTURE DAMAGE			
	Final Distortion of Cross Sectional Shape			
	END CLOSURES			
	Nose Cap			
	Tail Cap			
	PYLON CONDITION			
	FUEL & AIR FITTING CON	DITION		
Ref. Para. 4.7.4:	DELAMINATIONS			
	Results of Tap Test for	r Delaminations		
	(Supply goaled sket	ch of gize leastion and approximate		
	shape).	ch of size, location and approximate		
		7		
	FIBER SCIENCE, INC.	NO. QTP-2191 Section "S"		
	SALT LAKE CITY, UTAH			
		DATE: 11/20/80 PAGE 18 OF 21		

	Describe Damaged Condition the Tank	of Impacted Area of
	(Supply a scaled sketch of of impact area.)	the size and approximate shape
f. Para 4.7.6:	<u>PHOTOGRAPHS</u>	
	Number Photographs and Ide	ntify Locations
	PHOTO LOCATION	PHOTO LOCATION
	1.	7.
	2.	8
	3.	9.
	4.	10.
	5.	11
	6.	12.
f. Para. 4.7.7	DISSECTION OF THE TANK	
	Approved By	Date
	Condition of Frames	
	Condition of Probe	
•	44.41.41.41.41.41.41.41.41.41.41.41.41.4	

SALT LAKE CITY, UTAH

DATE 11/20/80

PAGE 19

OF 21

Condition o	of Fuel Line		
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "S"

DATE: 11/20/80

PAGE 20 OF 21

	EVALUATION OF	DATA
CAMERAS:		
PRESSURE RECORDINGS):	
		·
A	·	
STRAIN RECORDINGS:		ting the same of t
		
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		1
	FIBER SCIENCE, INC.	NO. QTP-2191 Section "S"
	SALT LAKE CITY, UTAH	DATE: 11/20/80 PAGE 21 OF

#PE 100 A/70

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DOCUMENT NUMBER

QTP-2191 SECTION "T"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR STATIC JETTISON TEST

Ī					REVISIONS		
	LTR.	DATE	PREPARED	APPROVED		DESCR	IPTION
ļ							
į							
		<u> </u>					
	PREPA	RED BY:	D/	ATE:			
	R	ichard Lym	ian 9,	/11/81			FIBER SCIENCE, INC.
1	CHECK	KED BY:	D/	ATE:			SALT LAKE CITY, UTAH
	-	Vinder 2	Mine 9	1681	NO	QTP-2191 Se	ection "T"
	APPR	HED BY:	D.	ATE:			
	(2)	a fin	Lik ?	117/81	DATE.	9/11/81	PAGE 1 OF

1.0 SCOPE

This procedure covers the requirements for static Jettison testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831

Test Reports, Preparation of.

2.2 ENGINEERING EXHIBIT

WR-ALC/MMSRCB 450-1

Tank - H-53 Crash Survivable--450 gallon

external fuel.

2.3 DRAWINGS

FIBER SCIENCE

2191-001

Tank - Installation, 450 gallon

H-53.

SARGENT FLETCHER

27-450-4400

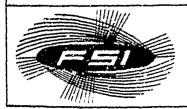
Pylon Assembly - 450 gallon fuel

tank.

27-450-48022

Tank Assembly - Fuselage 450

Gallon fuel.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81

PAGE 2 OF 17

3.0 REQUIREMENTS

3.1 TEST ARTICLES

Two empty tank assemblies (2191-001) and (27-450-48022) shall be mounted to two pylon (27-450-4400) assemblies which in turn is mounted separately to a test rig. Each tank and pylon assembly shall be subjected to a jettisoned grop test from an elevated static position as described in Engineering Exhibit WR-ALC/MMSRCB 450-1.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Concept A or Concept B Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter. Other concepts of dropping the tank may be recommended but must be approved before use.

3.3 <u>TEST METHOD</u>

The tanks shall be empty and suspended in a 2° nose down position by the pylon support points and secured to the static test rig at least 64 feet above the ground.

The tank shall then be force ejected (jettison) from the static test rig using the ejection mechanism contained within the tank pylon 27-450-4400. The 2190-001 tank shall have a jettison characteristic equal to or better than the 27-450-48022 tank, that is less or equivalent roll, less or equivalent pitch and less or equivalent yaw.

3.4 TEST INSTRUMENTATION

Two high speed 16 mm movie cameras shall be used to record the jettison characteristics. Each camera shall be capable of photographing 200 frames per second minimum. One camera shall photograph the side view of the jettison characteristic and the other an end view. The cameras shall be sychronized with a timing device so that jettison characteristics can be compared relative to time and distance after the test is complete.



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 3 OF 17

3.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within \pm 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with paragraph 4 of this document.

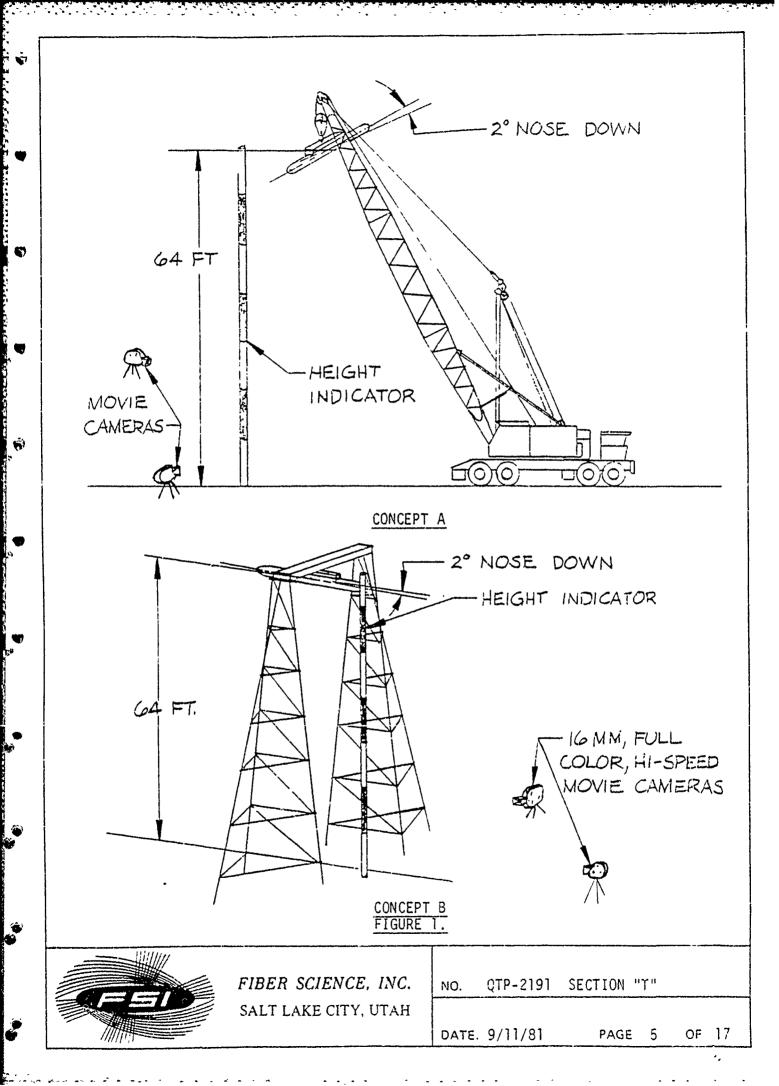
3.6 DOCUMENTATION

At the conclusion of testing a test report will be prepared for submission to the contractor.

FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 4 OF 17



4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the test rig for shipping damage to the test site. The results of this examination shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

The tank should be empty of all fuel or other liquids and shall then be mounted to the test rig and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviation shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of WR-ALC/MMSRCB 450-1 Engineering Exhibit and approved by an F.S.I. authorized test engineer and an authorized Government representative.

4.4 <u>INSTRUMENTATION AND TEST EQUIPMENT</u>



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH NO. QTP-2191 Section "T"

DATE. 9/11/81 PAGE 6 OF 17

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrumentation has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: Timing devices, cameras, and recorders shall be installed and positioned to adequately record the jettison characteristics until the tank impacts the ground.

4.4.3 OPERATION

All instrumentation and test equipment including the ejection (jettisoning) gun shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.4.4 PHOTOGRAPHS

At least six (6) color photographs shall be taken of each test arrangement and the condition of the tank after it has impacted the ground.

4.5 GUN LOADING

The ejection gun cartridge chamber shall be loaded with 2 cartridges using a standard load. Safety precautions should be taken to insure load is properly installed and that the breech is properly closed and locked.

4.6 STATIC JETTISON

With all instrumentation synchronized and ready for operation, the tank shall be jettisoned from a 2° nose down position at the height requirements of paragraph 3.3.



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 7 OF 17

4.7 <u>POST JETTISON EXAMINATION</u>

4.7.1 CRASH IMPACT

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Each tank shall be examined after the test for crash impact damage. The data recorded shall be for information purposes only.

4.7.2 JETTISON CHARACTERISTICS

The 16 mm movies from each test shall be developed and examined. Each tank shall be compared for Jettison characteristics relative to roll, pitch and yaw at corresponding time intervals after jettisoning. Evaluation of the jettisoning characteristics shall be to the requirements of paragraph 3.3.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all high speed film, photographs and expended tanks. Expended tanks shall be returned to Fiber Science for post evaluation in the same shipping containers they were received in.

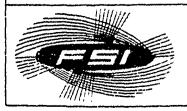


FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 8 OF 17

APPENDIX "A"
TEST DATA SHEETS



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 9

OF 17

TEST DATA SHEET

QTR-2191 SECTION "T"

Testing Activity	Activity Test Engr
Tank Serial No.	F.S.I. Test Engr.
Test Date	Government Rep.
	EXAMINATION OF PRODUCT
Ref. Para. 4.1:	Visual Inspection
	MOUNTING
Ref. Para. 4.2:	Aircraft Simulated Attachment
	Deviations If Any
_	



FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81 PAGE 10 OF 17

	ARRANGEMENT			
Ref. Para. 4.3:	Approved Test Arrangement (Ref. Figure 1 WR-ALC/MMSRCB 450-1 Engineering Exhibit.)			
	Testing Activity Approval			
	Approved By	Date		
	F.S.I. Test Engineer Approval			
	Approved By	Date		
	Government Approval			
	Approved ByDate			
	Minimum of two signatures requir	ed.		
	INSTRUMENTATION			
Cof Dana A A 1:	CHECK INSTRUMENTATION CALIBRATIO	331		
Rei. Fara. 4.4.1.	CHECK INSTRUMENTATION CALIBRATIO	<u>IN</u>		
Rei. Faid. 4.4.1.	ITEM	CALIBRATION DATE		
Rei. Faid. 4.4.1.				
Rei. Faid. 4.4.1.	ITEM	CALIBRATION DATE		
Rei, Faid. 4.4.1.	ITEM Cameras (if applicable)	CALIBRATION DATE		
Rei, Faid. 4.4.1.	ITEM Cameras (if applicable) Timing Devices	CALIBRATION DATE		
Rel. Fala. 4.4.1.	ITEM Cameras (if applicable) Timing Devices Recorders Other Instruments	CALIBRATION DATE		
Rei. Faid. 4.4.1.	ITEM Cameras (if applicable) Timing Devices Recorders Other Instruments 1.	CALIBRATION DATE		
Rel. Fala. 4.4.1.	ITEM Cameras (if applicable) Timing Devices Recorders Other Instruments 1	CALIBRATION DATE		
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

QTP-2191 Section "T" NO.

PAGE]] DATE: 9/11/81

OF 17

Ref. Para. 4.4.2:	CHECK PROPER INSTALLATION	
	ITEM	REMARKS
	Tank	
	Cartridges	
	Cameras	
	Timing Devices	
	Recorders	
	Other Instruments	
	1.	
	2	
	3	
	4.	
Ref. Para. 4.4.3:	CHECK PROPER OPERATION	
	ITEM	REMARKS
	Ejection Gun	
	Hook Mechanism	
	Cameras	
	Timing Devices	
	Recorders	
	Other Instruments	
	1	
	2	
	3.	
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	FIBER SCIENCE, INC. NO OTE	2-2191 Section "T"
FSI	SALT LAKE CITY, UTAH	2131 00011011 1

DATE: 9/11/81

12 OF 17

PAGE

Ref. Para. 4.4.4	PHOTOGRAPHS			
	Number Photographs and Identify Locations			
	PHOTO LOCATION	PHOTO LOCATION		
	1.	4.		
	2.	5.		
	3.	6.		
	GUN LOAD	ING		
Ref. Para. 4.5	LOAD EJECTION GUN WIT	H 2 STANDARD LOAD CARTRIDGES		
	ITEM	REMARKS		
	Cartridge Load			
	Install Cartridges			
	Check Installation			
	Close and lock Breach			
	STATIC JETT	ISON		
Ref. Para. 4.6	TETTISON TANK WITH AL	L INSTRUMENTATION SYNCHRONIZED		
Rei. Fara. 4.0	ITEM	OPERATION REMARKS		
	Ejection Gun	OI LIMITON KEPAKKO		
	Hook Mechanism			
	Cameras			
	Timing Devices			
	Recorders			
	Other Instruments			
	1.			
	2.			
	FIBER SCIENCE, INC.	NO. QTP-2191 Section "T"		
	SALT LAKE CITY, UTAH	DATE: 9/11/81 PAGE 13 OF 17		

POST JETTISON EXAMINATION

CRASH IMPACT

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Ref. Para. 4.7.1	GENERAL APPEARANCE
	RUPTURES
	Locations
	1.
	2.
	3.
	4
	Extent of Damage
	1.
	2
	4.
	4 ,



FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE9/11/81

PAGE 14 OF 17

JETTISON CHARACTERISTICS

4.7.2 COMPARE JETTISON CHARACTERISTICS OF 2191-001 TANK ASSEMBLY TO 27-450-48022 TANK ASSEMBLY PER PARAGRAPH 3.3.

ROLL CHARACTERISTICS		ELAPSED TIME
27-450-48022	2191-001	
		<u>JETTISON</u>
		.2 Sec.
		.4 Sec.
···		.8 Sec.
		1.4 Sec.
		AT IMPACT
PITCH CHARACTERISTICS		ELAPSED TIME
27-450-48022	2191-001	
		<u>JETTISON</u>
		.2 Sec.
		<u>.4 Sec.</u>
		<u>.8 Sec.</u>
		1.4 Sec.
		AT IMPACT
YAW CHARACTERISTICS		ELAPSED TIME
27-450-48022	2191-001	
		<u>JETT ISON</u>
		.2 Sec.
		<u>.4 Sec.</u>
		.8 Sec.
•		1.4 Sec.
		AT IMPACT
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE9/11/81

PAGE 15

OF 17

	<u>EVALUATION O</u>	F DATA
CAMERAS:		

-		
TIMING DEVICES:		
	11	
RECORDERS:		
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•		
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PAGE 16

OF 17

DATE: 9/11/81

EVALUATION OF DATA

CONTINUED

ETTISON CHARACTERIST	ICS:		·		
					
······································		· · · · · · · · · · · · · · · · · · ·			

RASH IMPACT DAMAGE:					
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FIBER SCIENCE, INC. SALT LAKE CITY, UTAH

NO. QTP-2191 Section "T"

DATE: 9/11/81

PAGE

17 _{OF} 17